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Fertilizer Use and Marketing Policy Workshop

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Kigali, Rwanda

Organized by Abt Associates Inc.
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Table of Contents

Foreword

Dr. Andy Cook, Policy Advisor, Abt Associates Inc./MINAGRI

Rwandan use of fertilisers falls far short of the norm for East Africa. In a context of an increasing population, seriously diminishing soil fertility, and limited contributions from manure and other organic sources, the solution must be to increase chemical-fertiliser inputs to Rwandan agriculture. To ensure this increase, bottlenecks must be removed all along the marketing and production chain for fertiliser – from importing and marketing to agricultural extension.

Over the course of the late 1990s, the Rwandan government removed import taxes on fertiliser imports and gave responsibility for fertiliser marketing to the private sector; and, starting in 2000, a World Bank financed project has begun promoting fertiliser imports and marketing. In addition, an important report documenting the profitability of fertiliser use by region and crop has appeared.

In this context, Rwanda's Ministry of Agriculture, Livestock Resources and Forestry held a *Policy workshop on fertiliser use and marketing* on Thursday, 22nd and Friday, 23rd February 2001 to review progress and to develop a strategy and an action plan to promote the sustainable rapid growth of fertiliser use Rwanda. The workshop reviewed progress, opportunities and constraints in various areas of the marketing and use of fertiliser and thus identified key areas where government policy can make a difference in increasing Rwandan agricultural production. The consensus generated among a range of policy-makers and informed technicians, partners and economic operators formed the basis for an *Action plan for fertiliser policy in Rwanda*.

The papers presented and discussed in the workshop assessed the scope for growth of fertilizer use, identified difficulties in raising the present level of use, examined alternative ways to overcome critical bottlenecks, and reviewed experiences of other developing countries to draw policy lessons useful to Rwanda.

Desai opened the workshop by emphasising that removing the soil-fertility constraint is the single most important task in the intensification of Rwanda's agriculture. He then turned to outlining a framework within which the other presenters' contributions should be viewed and in which he would later craft the consensus of the workshop into a strategy and action plan.

The paper by Kelly, Mpyisi, Murekezi and Neven reviewed the past trends in fertilizer consumption, drew attention to present pattern of fertilizer use and farmers' difficulties in using this input, and presented estimates of the agro-economic potential of fertilizer use. Murekezi presented an overview of the place of fertilizer in agricultural and extension systems of Rwanda. The two papers by Cook reviewed fertilizer marketing and imports, and also drew attention to notable recent developments. Nyirimana highlighted the potential and constraints of the Agricultural and Rural Market Development Project. Finally, the papers by Allgood & Bumb and by Niyungeko covered the evolution and characteristics of fertilizer-sector development in four East African countries – Kenya, Uganda, Tanzania and Burundi.

There was a clear consensus on the need to step up fertilizer use in Rwanda, but without downplaying the importance of organic manure and soil conservation. A variety of difficulties in rapid growth of fertilizer consumption were also pointed out. These pertained to farmers' low effective demand due to lack of experience and knowledge in fertilizer use, cash constraints, non-availability of fertilizers at

convenient locations, and high prices of fertilizers. On the supply side, the principal obstacles were the rudimentary state of fertilizer distribution, as well as unsteady growth in, and high cost of, fertilizer imports to land-locked Rwanda.

At the same time, the papers and workshop discussion also revealed some positive signs about the prospects for growth in fertilizer use. There was a substantial scope for profitable use of fertilizers under the prevailing environment of responses of crops to fertilizer application, given prices of crops and fertilizers. Fertilizer was given a prime place in the strategy of intensification and commercialization. This was in sharp contrast to the policy to discourage fertilizer use for many years. More importantly still, the government had begun the process of creating an enabling policy environment for growth in fertilizer use. Subsidized distribution of fertilizers received under foreign aid was discontinued, and this input was exempted from 15% value-added tax (VAT) and 5% import tax. Also, the Agricultural and Rural Market Development Project (ARMDP), financed by a World Bank credit, was launched in 2000, providing a line of credit to importers at attractive interest rates, promoting the expansion of the distribution system, creating fertilizer awareness among farmers, and training them in fertilizer practices. To further expand the geographical base of growth in fertilizer use, the Ministry of Agriculture has launched a program of fertilizer demonstrations.

All these developments have had a clear positive impact on the fertilizer scene. Total fertilizer imports in 2000 were in excess of 8,500 tonnes. Nearly a quarter of this was due to the private-sector system that had come into existence in response to the exemption of fertilizers from VAT and import taxes, and to increasing fertilizer demand of Irish-potato growers.

Desai synthesises the positive and the negative into a strategy and action plan that identifies the need for a co-ordinated *Big Push* to take advantage of the benign policy environment in order to accelerate the supply of fertiliser to the Rwandan farmer. After showing that there exists ample agronomic scope for significant leaps forward in sustainably increased fertiliser use, he provides a strategy for the *Big Push* and then lays out four necessary elements of a feasible *Action Plan* that would allow this to happen:

1. Increased on-farm demonstrations of the profitability of fertiliser use;
2. Steady growth in total fertiliser imports from the world market;
3. Training programmes for traders, agronomists and others supporting the *Big Push;* and
4. The establishment of a dedicated Department of Marketing Services within the Ministry of Agriculture, Livestock Resources and Forestry.

The *Agricultural Policy Development Project*, managed by Abt Associates Inc., and the *Food Security Research Project*, managed by Michigan State University, jointly organised the workshop. USAID funds both projects.

List of Acronyms

APNI	Project Appui au Programme National Intrants
ARMD	Agricultural and Rural Markets Development Project
BNDE	Banque Nationale de Développment Economique (National Bank for Economic Development) Burundi
BNR	Banque Nationale du Rwanda
BRB	Banque de la République du Burundi (Republic of Burundi Bank)
BTC	Burundi Tobacco Company
CNA	Commission Nationale de l'Agriculture
COGERCO	Compagnie de Gérance du Coton (Cotton Marketing Corporation) Burundi
DAP	Diammonium phosphate
DGA	Direction Générale de l'Agriculture (General Directorate of Agriculture)
DPAE	Direction Provinciale de l'Agriculture et de l'Elevage (Regional Directorate of Agriculture and Livestock), Burundi
DRSA	Département Régional des Services Agricoles (Department of Regional Agricultural Services)
DVC	Département de la Vulgarisation et de la Commercialisation (Department of Extension and Marketing.)
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAO	Food and Agriculture Organization (Organisation des Nations Unies pour l'Agriculture et l'Alimentation)
FSRP	Food Security Research Project
GOR	Government of Rwanda
HPB	Huilerie de Palme du Burundi (Burundi Palm oil Industry)
ICHA	Impot sur le Chiffre d'Affaires
IFAD	International Fund for Agricultural Development
IFS	Initiative sur la Fertilité des Sols (Soil Fertility Initiative.)
IRAZ	Institut de Recherche Agronomique et Zootechnique de la CEPGL (Institute of Agriculture and Livestock for Great Lakes Economic Community)
ISABU	Institut des Sciences Agronomiques du Burundi (Burundi Agricultural Science Institute)
ISAR	Institut des Sciences Agronomiques du Rwanad
ISAR	Institut des Sciences Agronomiques du Rwanda (Rwanda Institute of Agricultural Sciences.)
KC1	potassium chlorate
MINAGRI	Ministry of Agriculture, Animal Resources, and Forestry
MINAGRI	Ministère de l'Agriculture, de l'Elevage et des Forêts
n.d.	non disponible (not available)
NGOs	Non-governmental organizations
NPK	Nitrogen, phosphorus, and potassium fertilizers
NPK	Nitrogen – Phosphorus – Potassium
OCIBU	Office des Cafés du Burundi (Burundi Coffee Authority)
OCIR	Office des Cultures Industrielles du Rwanda

OCIR	Office des Cultures Industrielles du Rwanda (Rwandan parastatal industrial crops company)
OHP	Office de l'Huile de Palme (Palm Oil Authority)
OTB	Office du Thé du Burundi (Burundi Tea Authority)
PE	Programme Engrais (Fertiliser Programme)
PEARL	Partnership for Enhancing Agricultural Research and Linkages
PGERB	Projet de Gestion des Espaces Ruraux du Buberuka
R/D	Research-Development
SORWATHE	Société Rwandaise du Thé
SOSUMO	Société Sucrière du Moso (Moso Sugar Company)
SRDI	Société Régionale de Développement de l'Imbo (Imbo Regional Development Company)
T	Tonnes
TSP	Triple super phosphate fertilizers
UNR	Université Nationale du Rwanda
USAID	United States Agency for International Development

1. Introductions

1.1. Remarks of The Honorable Aaron Makuba

Minister of State for Agriculture, Ministry of Agriculture, Livestock and Forestry

Ladies and Gentlemen — Dear Participants,

As you know, the Rwanda Government has put food security among its major national priorities. In this country's context, agricultural intensification must be the mainstay of any sustainable agricultural policy.

The scarcity of land for large-scale farming, the very high demographic growth, the persistent food shortages since the 1980s and the low level in income generated by the other sectors of the national economy make it imperative to use intensive methods for our agriculture. This intensification must be aimed at boosting production, productivity and producers' incomes. Fertilisers, which are the subject of this two-day seminar, constitute one of the most important inputs for the agricultural sector.

The Ministry of Agriculture, Livestock Resources and Forestry attaches primordial importance to the use of agricultural inputs in general, with a special emphasis on fertilisers. The holding of this seminar bears testimony to our will to give priority to this sector. We are convinced that once this area is thoroughly understood, a significant part of the solution to certain challenges will be found.

The main challenges Rwanda is faced with in agriculture are as follows:

1. The heavy after-effects of the war and genocide that put the country under a difficult socio-economic predicament, which the country has to solve politically, socially and economically;
2. Rapid increase of food needs arising from high (over 3%) demographic growth that has to be contained;
3. Limited agricultural production capacity (scarcity of arable land, utilisation of rudimentary tools, low level use of inputs and consequent poor productivity of soils.

To meet these challenges, Rwanda has to face multiple constraints. These fall into two categories:
First, the most important is the need for a fundamental change of approach requiring the rural areas to adapt modern agriculture that is better adapted to markets and abandoning the traditional subsistence methods which have hitherto characterised farming in Rwanda.

Second, there are structural constraints that arise out of certain economic conditions as summarized below:

- The increase in agricultural production is first of all limited by: (a) limit opportunities for extensive farming of arable land and the continued parceling-out of farms; (b) the poor productivity of crops and livestock used in farming and the low level of protection of livestock health; and (c) the unfavorable macro-economic framework with prohibitive costs of inputs due especially to transport, absence of internal input distribution networks, shortage

or total absence of rural banking facilities, weaknesses of the private sector and, lastly, lack of professional skills in peasant organisations.

- The importation of food products in commercial quantities is limited by the low level of exports, which arises from the low quantity and poor quality of coffee, the continuous fall of world prices for that product, partial suspension of tea exports due to the destruction of some tea factories, the limited diversity of exports and, lastly, the absence of mineral resources and export-oriented industries, as well as services, that can bring in foreign exchange earnings.

- The stability of supplies is thwarted by the poor state of feeder roads that make difficult the circulation of goods; the disappearance, during the 1994 crisis, of the bulk of the national vehicle fleet; the breakdown of commercial networks in rural areas; and the absence of regulatory stocks.

- The access by all to adequate, healthy and varied diet is curtailed by the low purchasing power of households that have only small plots of land for farming. This is due to: failure by the secondary and tertiary sectors to absorb the excess rural manpower, the lack of qualifications of such manpower and a macro-economic framework that is hardly conducive to the development of small and medium enterprises in rural areas.

Among planned strategies, we may point out the following:

- Agricultural intensification through the increased use of inputs and better methods of production applied in cultivation and animal husbandry to boost crop and livestock productivity. (This requires use of high-performance seeds, fertilisers, pesticides, improved agricultural methods; regional crop zoning, crop prioritisation, enhancing quality and quantity of cash-crop production, genetic and husbandry improvement for livestock development, reafforestation of new areas, promotion of agro-forestry and rational utilisation of wood);

- Professionalisation of agriculture: (This involves mastering the techniques of production, marketing and processing of produce, which depends on the training level of our farmers/ranchers and their specialisation in profitable options);

- Rational soil and water utilisation;

- Marketing of agricultural products;

- Enhancing research and extension services.

The low fertility of most of Rwanda's soils thus requires the use of fertilisers in order to increase production improve farmers' living standards. Many studies have been conducted on fertiliser use and have come up with satisfactory findings.

However, fertiliser use remains generally low in our country. In certain cases demand is not satisfied, while in other cases fertilisers are made available but are not sufficiently used. A lot of efforts are thus required to make fertilisers available to consumers and for increased, more profitable fertiliser use.

During this workshop (which has brought together experts, importers and users), the papers to be presented will focus on the experience gained and/or observations concerning, among other issues, fertiliser imports, their distribution and marketing, related research and extension campaigns as well as certain aspects of fertiliser use. Exchange of ideas on the different papers should enable us to work out, in the near future, a plan of action to be followed for removing the bottlenecks that hamper the promotion of fertiliser marketing.

I hope that this workshop time will be fruitfully utilised and that the ensuing recommendations and conclusions will be very helpful to us in facing the fertiliser-related challenges in our country.

I hereby declare open this seminar on fertiliser use and marketing.

I thank you all and wish you good deliberations.

1.2. Remarks of Dr. John W. Mellor

Vice President, Abt Associates Inc.

Rwanda has one of the world's highest proportions of its population in poverty. That poverty results from unemployment, particularly in rural areas.

Recent large-scale data analyses that analyze the relation between the structure of economic growth and poverty reduction, over time and across countries, are consistent in showing that *agricultural and rural growth most effectively reduces poverty*. Studies by Martin Ravallion and his colleagues at the World Bank and by Peter Timmer and his colleagues, then at Harvard University, confirm earlier theoretical work by John Mellor, and empirical studies for India by Narian, Ahluwalia, and Mellor & Desai. These analyses show that the impact of agricultural growth on poverty reduction comes from the expenditure of rising farm incomes on rural, non-farm-produced goods and services. The provision of those goods and services is highly labor-intensive, far more so than even the most labor-intensive export industries in urban areas.

Rwanda's Ministry of Agriculture, Livestock Resources and Forestry has the strategy exactly right for accelerating agricultural growth and thereby maximizing the rate of poverty reduction and rural employment increase. The Ministry's program emphasizes the intensification and the commercialization of agriculture. That will provide the big increases in income needed for effective poverty reduction.

Prioritisation of agricultural intensification reflects recognition of the scarcity of land and therefore the need to increase output per hectare through high levels of input use and a shift to high-value crops and to livestock. The emphasis on commercialization reflects a recognition that increased incomes require specialization that, in turn, requires (a) purchasing many inputs, rather than producing them on the same farm and (b) specializing in the crops and livestock best suited to local agro-ecological and economic conditions. Farmers must buy and sell more in order to raise their incomes.

For at least twenty years, Rwandan farmers have been taking more nutrients out of the soil than they have put back. With high population pressure on the land, organic matter has not replaced more than a small fraction of those nutrients. In fact, nutrient depletion and the reduction in farm incomes have decreased the supply of organic matter. Thus, there has been a vicious circle of declining soil nutrients leading to declining organic matter. The result has been a reduction in crop yields and farm incomes and falling expenditure on rural non-farm goods and services, with consequent increased unemployment and poverty.

Therefore massive increases in application of inorganic fertilizers must be central to agricultural intensification, commercialization, rising incomes, and increased demand for rural non-farm goods and services. The extraordinarily low level of nutrient content of soils in Rwanda provides an opportunity for unusually high rates of growth as large quantities of nutrients are added to the soil. The paper in this volume by Valerie Kelly and Edson Mpyisi substantiates the extraordinarily high response of crops in Rwanda to increased quantities of soil nutrients.

In that context, one can define the components of agricultural growth in Rwanda. As the various papers will substantiate, a target of increasing fertilizer material by 5,000 tons per year over the next ten years would add four percentage points to the growth rate of agricultural GDP.

The large, World Bank-financed program for swamp reclamation will add approximately six percent to the cultivated area, even without accounting for the higher-than-average productivity of this land. That would add about 0.5 percent to the annual growth rate. In addition, Rwanda agriculture should be farmed with more intensive cropping patterns. Given the potential, adding another percentage point to the growth rate from such an increase in the proportion of the higher-value crops and of livestock is a reasonable target.

That adds up to a 5.5 percent growth rate in agriculture with 73 percent of this growth accounted for by fertilizer, 18 percent by switching to higher-value crops and livestock, and 9 percent by increased area. Fertilizer is truly the centerpiece of rapid agricultural growth.

From that agricultural growth rate one can calculate the rate of increase of farm incomes, calculate the initial base of rural non-farm employment, apply a standard multiplier of 1.5 (see writings by Mellor), and apply standard elasticities of employment with respect to output growth (0.6 for agriculture such as that for Rwanda and 0.9 for the rural non-farm sector) and calculate the rate of increase in employment following directly and indirectly from the agricultural growth. The resulting employment growth rate comes out at roughly twice the rate of growth of the rural labor force, leading to decreasing underemployment and eventually to rising rural wage rates. Both bring down poverty levels rapidly.

Gunvant Desai's paper conceptualizes how to think about rapid growth in fertilizer use and the papers by Anastase Murekezi, Andy Cook, Joseph Nyirimana, John Allgood and Balu Bumb, and Novat Nyungeko provide the information for diagnosing the needs for achieving rapid growth in fertilizer use. The process is indeed complex, requiring a tight sense of priority in what actions are taken in order to have maximum impact. Fortunately, the policy environment in Rwanda is now highly favorable for a takeoff in fertilizer use.

The favorable policy environment has resulted in a proliferation of traders in fertilizer, buying from various foreign sources, including nearby Nairobi. This diversity of competition must be encouraged

to grow and it is critical that government retain policies favorable to such proliferation and hence increased competition.

However, as emphasized by Desai, Rwanda is caught in a "low-level equilibrium trap" that makes it difficult to get onto the track of rapid growth in fertilizer use. Farmers use little fertilizer: indeed very few farmers use any fertilizer at all. As a result, fertilizer dealers see little market and have a limited interest in stocking fertilizer. And because there is not a widespread distribution system, farmers are not likely to find fertilizer even if they want it. The way out of this trap is a big push to increase fertilizer supplies and use by 5,000 tons per year initially and by 7,000 tons annually after a few years.

Rwanda now has an effective system of fertilizer demonstrations. They need to be expanded and many farmers and potential fertilizer retailers need to be brought to see the impressive results. The Ministry of Agriculture, Livestock Resources and Forestry must stand ready to diagnose and treat shortcomings in the attempt to add 5,000 tons of fertilizer use per year. That requires a monitoring system that tells how much fertilizer is being used on what crops, in what regions and by what types of farmers. In the longer run, an effective credit system will be needed and research must be stepped up. Until a credit system is established, use of fertilizer will be restricted to the larger, more prosperous farmers. In Asia, credit systems were present at an early stage in the development of fertiliser use, and the smallest farmers participated in fertilizer use – actually using it at higher application levels than the larger farmers. All these issues are treated at length in the ensuing papers.

Growth in agricultural production is the sum of increased production of specific commodities that have varying characteristics. The rapid use of fertilizer use planned for the next few years should concentrate on the commodities and areas that are most responsive to fertilizer, providing the largest increase in incomes. Success in these easier situations will facilitate spread to successively more difficult situations.

Potato farmers are already beginning to use substantial amounts of fertilizer, but there exists great potential to expand use to more farmers and to increase the area of potato grown. The result will be an increase in production far greater than domestic markets can absorb. Thus, attention must be given to bringing in many traders to buy up production and move it into other East African countries.

Tea and coffee have immense potential for increased production and will use much larger quantities of fertilizer. The Government of Rwanda is marching down the track of privatizing all aspects of these two sub-sectors. It is important that those policies be pursued vigorously and in a manner that encourages increased production and hence increased fertilizer use.

As incomes rise in Rwanda, the demand for livestock products will grow rapidly. It is important that production rise to meet that growing domestic demand. Four important, interrelated benefits flow from increased smallholder livestock production. First, it increases farm incomes and the employment multipliers. Second, it provides a market for increased production of maize, sorghum and other feed concentrates, thereby encouraging their production, and taking advantage of the favorable fertilizer response ratios they exhibit. Third, the extreme scarcity of organic matter will be gradually eliminated as livestock production in small farms increases. Fourth, it provides a flow of cash income that helps finance fertilizer use and other cash needs for intensification and commercialization of agriculture.

The following papers – particularly Desai's policy and action paper – lay out the requirements for rapid increase in fertilizer use. Success will require attention at the highest levels, a clear sense of priority, and foreign donor support. The result will be rapid rates of agricultural growth, vastly improved food security, and a precipitous decline in poverty.

1.3. Orientation Paper by Dr. Gunvant Desai

Consultant, Abt Associates Inc.

Fertilizer use in Rwanda is one of the lowest in Sub-Saharan Africa. More importantly, sustained growth in use is yet to begin even though fertilizer was introduced in the early 1970s. This was not just because of reasons such as farmers' poverty, semi-subsistence farming, and high cost of fertilizer imports in land-locked Rwanda. No need to promote fertilizer use was seen despite growing population pressure on land. It was believed that soil fertility was generally high, and it could be maintained through traditional farming practices like use of organic manure, crop rotations, fallowing, and anti-erosion techniques.

This mindset started changing from the late 1980s with growing evidence on declining soil fertility, and its impact on trends of crop yields. It has also become increasingly clear that there is no practicable alternative to fertilizers in effectively tackling the soil fertility constraint to growth in agricultural production. Consequently, now the pertinent question is not *whether* fertilizer is important but *how* to increase its use under difficult circumstances.

The present workshop is designed to address this question. Its ultimate objective is to make prudent recommendations to develop an enabling policy environment for *sustainable* rapid growth of fertilizer use in Rwanda. This calls for an identification of major difficulties in growth of fertilizer use, their relative importance, and a critical understanding of alternative ways to tackle them.

The workshop papers provide analytical reviews of major systems affecting fertilizer use in Rwanda and an overview of the fertilizer sectors in other East African countries. As one would expect, the papers bring out various difficulties in raising fertilizer use. To facilitate discussion of these findings to draw policy conclusions, this paper presents a framework based on research on experiences of several countries. It helps in understanding *how* growth of fertilizer use occurs under typical circumstances of developing countries, the multi-faceted nature of this process, and the complexities in developing prudent policies to accelerate growth in the use of this input. The single most important message of the framework is not to view various difficulties in isolation of each other, or to consider all problems as equally serious and urgent in developing an enabling policy environment.

The Framework

In a developing country with persistent low fertilizer use, it seems appropriate to view actual levels as *outcomes* of the conversion of the fertilizer potential into farmers' demand for this input, and this demand being met by fertilizer distribution and supply systems. Fertilizer potential, on a given unit of land, is defined as the maximum amount of fertilizer that could be used on that unit to increase production of crops. Total fertilizer potential is the aggregation of the potentials on all units of cultivated land. This interpretation of observed fertilizer use is more appropriate than an expression of

fertilizer demand because of two reasons First, the total *potential* is almost always much larger than total *actual use*. Second, the systems behind conversion of the potential into farmers' demand and eventually into actual use are either nonexistent or severely underdeveloped.

Viewed thus, four conditions need to be fulfilled to break the vicious circle of persistent low fertilizer use and underdeveloped systems: (1) rapid conversion of the potential into farmers' effective demand for or fertilizers, (2) geographical expansion of fertilizer distribution system, (3) continuous growth of total fertilizer supply, and (4) enlargement of fertilizer potential. Fulfillment of the first three conditions results in growth of total fertilizer use through tapping the unexploited fertilizer potential. The fourth condition raises the maximum level up to which total fertilizer could grow. Since fulfilling these conditions are not one-shot events, we may call them *processes* that develop systems needed for growth of fertilizer use. The *pace, pattern* and *sustainability* of growth in total fertilizer use depend on balanced development and efficiency in the workings of these processes.

Each process comprises a number of activities, and depends on a variety of factors. The conversion of potential into farmers' effective demand obviously depends on prices of fertilizers and crops. But, when actual use is below the potential and many farmers lack experience of fertilizer use, the *pace* of conversion is often determined by fertilizer promotion activities, timely availability of fertilizers and credit at convenient locations, and development of assured markets for output. Sustained growth in total fertilizer supply depends on establishment of cost-effective domestic fertilizer plants and/or a reliable system to import fertilizers. The geographic dispersion of the fertilizer distribution system and efficiency in its workings depends on the development of physical infrastructure like roads, transportation and storage facilities and institutions relevant to input marketing. The enlargement of fertilizer potential depends on increasing fertilizer response through development and spread of improved technology, and investment in the conservation and development of land and water resources

Furthermore, each process is affected by one or more activities in the other processes. To illustrate, the conversion of potential into farmers' demand depends not just agricultural extension and fertilizer promoting activities but also on timely and adequate availability of fertilizers to farmers. Similarly, sustained growth in total fertilizer supply depends on growth in farmers' fertilizer demand, and the level of development in the fertilizer distribution system. Conversely, the geographical expansion of the fertilizer distribution system depends on *sustained* growth in total fertilizer supply and rapid conversion of the potential into farmers' demand for this input. Finally, technological progress and development of land and water resources that enlarge fertilizer potential depend on private and social returns on these activities. And these, in turn, depend on the level of development in fertilizer distribution and supply systems.

There are four main reasons why the challenge of developing an enabling fertilizer policy environment in Rwanda should be addressed in this framework.

First, it reminds us that the task of generating sustainable growth of fertilizer use is both vast and multi-faceted. This is because none of the four processes is fully in place as yet. Therefore, the task cannot be addressed effectively through simplistic thinking and one-shot policies like providing fertilizer subsidies to expand farmers' demand, or privatization of all fertilizer sector activities. What is needed a comprehensive vision of the sound and sustainable development of all four processes, a set of practicable policies, which are consistent with each other, and a time-bound plan of actions.

Second, in the early stages of growth in fertilizer use, different agencies -- the government, private sector, farmers' associations, and NGOs etc., -- have different strengths and weaknesses in sustainable development of the four processes. Their relative roles should be based on these considerations, and the interdependence of the four processes.

Third, the framework incorporates all major activities and factors affecting the pace, pattern and sustainability of growth of fertilizer use. Moreover, they are considered not in isolation of each other but as interacting parts of the four processes behind growth of fertilizer use. This conceptualization helps in identifying the most binding constraints to growth in fertilizer use, and alternative policy instruments to overcome it. To illustrate, inadequacy of farmers' fertilizer demand is commonly considered the most binding constraint. This could be addressed not only through fertilizer subsidies but also through accelerating fertilizer promotion in regions with unexploited potential, raising fertilizer response through rapid diffusion of available improved crop varieties, and improvements in fertilizer and output marketing systems that results in lower fertilizer prices and higher crop prices.

Finally, the framework views growth in total fertilizer use as a movement towards the potential. Thus, in the short-run, it points at the scope of growth in fertilizer use through tapping the unexploited fertilizer potential, especially in situations characterized by high fertilizer response and relatively better developed physical infrastructure and institutions. At the same time, it also draws attention to policies needed for technological progress to raise fertilizer productivity and potential for sustaining continuous growth in fertilizer demand without subsidies.

Other Countries' Experiences

Experience of several developing countries, interpreted in the above framework, provides some instructive analytical findings and policy lessons.

1. Beginnings of Fertilizer Use: In virtually all countries, fertilizer use began with a few farmers, usually in regions with relatively better-developed physical and institutional infrastructure. Also, initially only a few crops were fertilized. These were crops with superior fertilizer response that were produced mainly for market. From such beginnings, the use spread over time to a growing number of farmers, at many more locations, and on several crops. The resulting growth in aggregate fertilizer use was due to the conversion of the potential into actual use. Its pace was determined by the vigor with which the first three processes (described above) operated in a well-coordinated manner.

2. Crucial Importance of Total Fertilizer Supply: From empirical evidence on low fertilizer use and farmers' circumstance, slow growth in fertilizer use was commonly attributed to lack of farmers' demand for this input. But probing research using the framework presented above often revealed that, in the early stage, the most binding constraint to rapid growth in use was poor and unsteady growth of total fertilizer supply. This constrained efforts of the extension system and private distributors to promote the use at growing number of locations and on many more crops. It also slowed down the geographical expansion of the fertilizer distribution system. Fertilizer shortages resulting from sluggish or unsteady growth in total supply also gave rise to various deficiencies in the distribution system, and encouraged political and bureaucratic interventions in the working of the fertilizer distribution and pricing systems. These had adverse effects on sound development of the fertilizer sector despite the importance given to this input in raising agricultural production.

3. Importance of Technological Progress: The spread of fertilizer responsive varieties of several major crops has played a key role in accelerating growth of fertilizer use in many countries after 1960s. These varieties substantially raised not only fertilizer potential but also the response of crops to fertilizer application. This had unprecedented impact on (i) growth in farmers' demand for fertilizer by raising returns on its use, (ii) dealers' returns from fertilizer marketing through enlarging the volume of business, and (iii) investment in fertilizer production and imports.

4. Role of Public Policies: Public policies have played a pervasive role in influencing the development and working of the processes behind growth of fertilizer use. A critical examination of the experience with these policies also provides some useful lessons for discussing policy requirements in Rwanda.

On the demand side, the policies were based on both price and non-price instruments. Many governments relied on fertilizer subsidies to accelerate fertilizer adoption by farmers. But typically this had limited success because growth in fertilizer use brought in its wake growing burden of fertilizer subsidies on fiscal resources. Often this burden forced governments to restrict fertilizer imports. This had adverse impact on further development and sustainability of the processes behind growth in fertilizer use. Worse still, subsidized prices often encouraged inefficiency in farmers' fertilizer practices making the growth in total use chronically dependent on subsidies. Sometimes excessive fertilizer use resulting from subsidies has also caused negative environmental effects.

Major non-price instruments on the demand side included fertilizer demonstrations to spread fertilizer awareness and adoption, farmers' education in fertilizer practices based on location-specific research, promotion of fertilizer responsive crop varieties, provision of credit, and improvements in marketing systems for crops. These non-price instruments were consistently more effective than fertilizer subsides in sustaining rapid growth in farmers' demand for fertilizers.

In generating growth of total fertilizer supply, many governments were directly involved. This was mainly due to virtual absence of the private sector in fertilizer production and imports due to small volume of business, economies of scale in these activities, and chronic foreign exchange constraints. Where fertilizer was accorded high priority in agricultural policy, and adequate public resources were allocated for growth in total fertilizer supply, the policy facilitated rapid conversion of the potential into actual use. However, persistence of this policy beyond the early stages lowered economic efficiency in enlarging total fertilizer supply due to generally known shortcomings of the public sector in commercial activities.

The involvement of public agencies in fertilizer distribution was typically due to fertilizer shortages. Often the primary objective was to allocate limited supply at controlled prices to achieve specific crop production goals. But this seldom worked successfully. Worse still, it delayed the development of a competitive, market-oriented, fertilizer distribution system until constraints on growth of total fertilizer supply were eased.

Finally, public policies played a key role in technological progress that accelerated growth in fertilizer use through investment in agricultural research and extension, and in creating an enabling environment for a vigorous play of the four processes.

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2. Fertiliser Consumption in Rwanda: Past Trends, Future Potential, and Determinants

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Fertilizer consumption in Rwanda has always been extremely low in both relative and absolute terms. Aggregate national consumption from 1980 to present rarely exceeded 5,000 tons per year.[2] Average consumption per hectare of cultivated land is generally estimated at < 4 kg. This contrasts sharply with averages (ranging from 9-11 kg/ha during the last decade) for Sub-Saharan Africa in general, which continues to have the lowest fertilizer consumption of any region in the world.

2.1. Pre-war period (to 1994)

Interest in fertilizer in Rwanda can be traced back to the early 1970s when *Institut des Sciences Agronomiques du Rwanda* (ISAR) began to conduct fertilizer trials. During the early 1980s, FAO funded projects to test and promote fertilizer in the Butaré and Gikongoro prefectures, but there was no evidence of a national commitment to promoting widespread adoption of inorganic fertilizers at that time. Quite the contrary, the Government of Rwanda (GOR) was following a policy of agricultural self-sufficiency that discouraged fertilizer use. Rwandan soils were considered generally fertile. It was believed that fertility could be maintained by using locally available organic fertilizers in combination with crop rotations and anti-erosion techniques. Inorganic fertilizers were expensive and needed to be imported–factors which limited their appeal to a government aiming for self-sufficiency (CNA 1991).

By the late 1980s, however, there were documented signs of declining agricultural productivity. Interest in the potential role of inorganic fertilizer began to grow and many projects that included fertilizer components were launched. During this period, fertilizer used on food crops was generally NPK (primarily 17-17-17), representing 68% of fertilizer imports by the *Projet Appui au Programme National Intrants* (APNI) from 1984-1987. Phosphate fertilizers (DAP and TSP) represented 8% and

[1] The authors wish to thank Alain Houyoux of the European Union (PASAR) for his assistance with the parts of this paper that draw on the EU market price and fertilizer import data bases as well as for his help in reviewing earlier drafts of this document. Comments on earlier drafts from Gunvant Desai and John Mellor are also much appreciated.

[2] We attempted to make a distinction between fertilizer consumption (i.e., off-take or use) and fertilizer imports, but we found only one reference citing consumption figures (Mujyebumba 1997). We identified multiple sources of import data, most of them reporting different numbers. The differences among the various reports appear to be because of differences in criteria used for attributing imports to a particular year. To avoid confusion, Table 1 reports the most recent import data obtained from the BNR that monitors fertilizer imports through requests for foreign exchange and customs data.

urea 6% of APNI imports. Fertilizers for industrial crops (NPKs such as 20.10.10) accounted for the remaining 19% of imports during this period.
Extensive use of 17-17-17 was stimulated by donors' (European and Japanese) willingness to offer it as in-kind aid. Consequently, it became the fertilizer used in official MINAGRI recommendations.

Despite the many fertilizer projects (FAO trials and demonstration plots as well as efforts by bilateral donors), aggregate consumption reached a peak of only 6,593 tons by 1991. Consumption data are not available for the rest of the pre-war period. Data from the *Banque Nationale du Ruanda* (BNR) suggest that there may have been growth in consumption just prior to the war because 1993 imports reached an all-time high of 13,192 tons (Table 1). However, consultation with knowledgeable persons failed to provide a solid explanation for this unusual increase in fertilizer imports during 1993. The consensus is that these imports, primarily ammonium and nitrate products, were never used for agricultural purposes, but may have been used for military purposes associated with the war effort[3].

Table 1: Fertilizer Import and Consumption Trends (tons)

Year	Imports	Consumption
1984	4,401	4,401
1985	3,529	3,529
1986	3,529	3,529
1987	4,090	4,090
1988	5,613	5,613
1989	7,463	1,481
1990	90	2,149
1991	7,490	6,593
1992	5,693	
1993	13,192	
1994	647	
1995	1,344	2,025
1996	1,173	1,775
1997	2,938	
1998	4,780	
1999	2,731	
2000	6,537	

Sources: Imports for 1984-1989 and all consumption data from Mujyebumba; imports for 1990-2000 from BNR.

[3] As most of the imports were ammonium based or nitrate fertilizers (rather than the more typical NPK compounds) there is a possibility that the imports were being used for non-agricultural purposes related to the war effort which was escalating during 1993

2.2. Post-war European Union Import Period (1995-1998)

In sharp contrast to the earlier emphasis on self-sufficiency and organic approaches to soil fertility and agricultural productivity, Rwanda's post-war agricultural policy has been strongly in favor of intensification using modern inputs and the transformation of Rwanda's semi-subsistence producers into commercial farmers. In support of this policy, the European Union managed a fertilizer import program from 1995-1998. The imports were sold to NGOs and private sector distributors who served as the relay to move inputs through farmers' associations to farmers. End distribution of these imports was a mix of aid (free or below cost distribution by NGOs), cash sales, and barter trade (crops for fertilizer). There was a subsidy on EU fertilizer sales declining from 50% in 1995 to 20% in 1998. Although there was no official change in MINAGRI extension recommendations during this period, one notes a gradual shift from 17-17-17 to increased use of DAP and urea during the short EU period: sales for the 1996A season were 90% NPK while those for the 1999A season were only 42% NPK with urea accounting for another 42% and DAP for 16%(EU fertilizer program data base).[4] Although the EU was the principal fertilizer importer from 1995-1998,OCIR Thé, SORWATHE, and OCIR Café were also importing limited quantities for use on tea and coffee while FAO and IFAD were importing small amounts in conjunction with development and relief programs (Murekezi 2000).

Even with EU assistance, consumption remained low during the entire period, and aggregate national imports peaked in 1998 at 4780 tons. Annual EU imports ranged from 2000-3000 tons, but there were large carry-over stocks every year. The EU program also experienced problems with unpaid input credit, forcing a reduction in the share of inputs distributed on credit in 1998 and a complete halt to credit sales in 1999. EU imports stopped in 1998 but distribution of carry-over stocks continued into 1999 while responsibility for fertilizer imports and distribution was gradually transferred to the Rwandan private sector.

2.3. Current Period (1999-present): Privatizing and Liberalizing the Market

Imports exhibited a temporary decline in 1999 (<3000 tons total) with the principal actors being one private sector trading company (which has since gone out of business) and OCIR Thé (Murekezi 2000). There is good evidence, however, of fertilizer import growth in 2000. BNR records showed imports of approximately 6500 tons for 2000–an encouraging sign. At least seven firms were involved in these fertilizer imports during 2000 (personal communication, Nyirimana).

The GOR made three policy decisions in late 1999 and early 2000 believed to have contributed to this growth in private sector imports. In late 1999 a law was passed requiring MINAGRI approval for all free distribution of fertilizers. This law was in response to complaints by private traders that they could not compete effectively in the fertilizer market if there continued to be free or subsidized distribution of fertilizers by donors and NGOs. In May 2000 fertilizers were officially declared exempt from ICHA[5] (15%) and entry (5%) taxes making it possible for importers to market fertilizer

[4] This apparent shift from NPK to DAP and urea was not the result of any intentional policy change promoted by EU personnel in Rwanda (personal communication, Houyoux).

[5] ICHA is *impot sur le chiffre d'affaires*.

Table 2: Input Use and Conservation Investments: 1991A vs. 2000A

	% of farms using specified input		% cultivated area covered*	
Type of input/investment	1991A	2000A	1991A	2000A
Chemical fertilisers or lime	7	5	5	3
Organic inputs	95	69	70	59
Conservation investments	93	65	76	65

Source: Estimated from MINAGRI/DSA survey data.
*In order to make the comparisons with 1991 data, we counted the entire area of a block if an input was used on any parcel within the block; this results in some over-estimation of area actually covered.

at lower retail prices (high prices are thought to be one of the key constraints to fertilizer uptake at the farm level). Also in late 2000, the World Bank Agricultural and Rural Markets Development (ARMD) project provided a line of credit at subsidized interest rates (9% rather than the market rate of 16%) to fertilizer importers. This line of credit was just beginning to be used during the third quarter of 2000.

Data on the product composition of recent imports is sketchy, but imports funded with the ARMD project credit were predominantly NPK and urea (BNR report, October 2000). There is also evidence that some NGOs (ARDI, CSC Gitarama, INADES) were distributing DAP fertilizers in 1999 and 2000 (FAO fertilizer program).

2.4. Patterns of Fertiliser Use

Information on recent use of inorganic fertilizers, organic fertilizers, and complementary investments in anti-erosion barriers comes from a survey conducted during the 2000A season by the MINAGRI's *Division des Statistiques Agricoles* (DSA) and the Food Security Research Project (FSRP). These results are compared to results from pre-war surveys conducted by the DSA. The survey examined input use during the 2000A season and also asked retrospective questions about fertilizer use from 1995-1999.

2.1.1. Fertilizer Use: 1995-1999

Survey results show that over the 1995-1999 period a total of 12% of farm households used inorganic fertilizer at least once. Based on recall of specific quantities of fertilizer used in 1998 and 1999, DSA estimated average annual consumption to have been 3504 tons (7008 tons for the two-year period).[6] More than half of these purchases were reported by farmers in Gisenyi where a substantial amount of fertilizer was applied to potatoes.

2.1.2. Fertilizer Use: 2000A

Overview. Five percent of farmers used inorganic fertilizers and/or lime on three percent of cultivated land during the 2000A season. These numbers are slightly lower than comparative numbers for 1991

[6] This estimate is approximately the same as the quantity of fertilizer imports reported in Table 1 for 1998-1999, a fact that increases our confidence in the survey data.

(7% of farms and 5% of area), however, the standard deviations for both the pre- and post-war data sets are very large and there is no statistically significant difference in fertilizer use between the two periods. Although only 3% of total cultivated area is fertilized, the spread of coverage varies sharply by crop, with an estimated 29% of rice, 21% of potatoes, and 19% of vegetable areas being fertilized. Surprisingly, only 3% of coffee area is fertilized.

Although many countries in Sub-Saharan Africa follow a pattern of fertilizer adoption whereby the largest farms (which are frequently the wealthiest) adopt fertilizer more rapidly than the smaller farms, this pattern is not evident in Rwanda. Fertilizer users during the 2000A season represented the same share of farms (4-5%) regardless of farm size category. In other words, we do not find a concentration of fertilizer users among the larger farms or a concentration of non-users among the smaller farms.

The use of anti-erosion barriers and organic fertilizers (primarily manure) appears to have declined dramatically from 1991 to 2000. The agronomic trial data upon which estimates of Rwandan fertilizer profitability are based include a basal dose of manure (generally 3-10 tons/ha.) and assume that land is protected from erosion (FAO 1995, Kelly and Murekezi 2000). A decline in the use of manure and anti-erosion investments could act as a major constraint to expansion of fertilizer uptake as it is likely to result in reduced yield response and profitability. Table 2 compares the data on pre- and post-war use of inorganic fertilizers, manure, and conservation investments. These sharp decreases in use of manure and conservation investments are not surprising given the loss of livestock during the war and the shortage of agricultural labor since the war. They do, however, signal the need for the GOR to promote programs to rebuild livestock numbers and stimulate investment in erosion control in conjunction with programs to promote the adoption of inorganic fertilizers. For example, only 50% of the area treated with inorganic fertilizers in 2000A was also treated with organic fertilizers. This varied substantially across prefectures. Fertilizer users in Kigali Rurale, Butaré, and Gikongoro complemented the inorganic fertilizers with organic supplements on 75% of the area to which inorganic fertilizers were applied while those in other prefecture did less well. In Gisenyi, where more than 50% of Rwanda's fertilizer was used, only 32% of the area fertilized received organic supplements.

Fertilizer Use by Prefecture and Crop. Although the 2000A survey data are not robust when disaggregated to the prefecture and crop levels, they are the only data now available on post war fertilizer use drawn from a randomly selected national sample. Consequently, we present the patterns revealed by this database, recognizing that the picture presented could be improved if supplemented with more detailed information collected at the local level.[7]

Table 3 shows that 1947 tons of fertilizer were used during the 2000A season. Forty-two percent of fertilizer consumed nationally was used on Irish potatoes and 21% on coffee. No other single crop represented any more than 6% of national consumption. Gisenyi consumed more fertilizer than all other prefectures combined (i.e., 56% of total 2000A consumption). Irish potatoes accounted for 51% and coffee 28% of fertilizer consumed in Gisenyi. Byumba was the second most important prefecture,

[7] The 2000A sample size is 1584 households of which only 72 (4.5%) used fertilizer, consequently several of the estimates of prefecture or crop level fertilizer use are based on a single observation and none of the cells in Table 3 are based on more than 10 observations.

consuming 18% of 2000A fertilizer; 68% of Byumba's fertilizer was used on Irish potatoes and 19% on beans.

Looking across each prefecture to identify the crop getting the largest quantity of fertilizer reveals a definite pattern of farmers applying fertilizers primarily to the crops with the more reliable output markets: Irish potatoes in Byumba, Gisenyi and Ruhengeri; rice in Cyangugu and Kigali Rural; vegetables in Butaré; tea in Kibuye; and bananas in Gikongoro and Umutara. Food crops such as beans, tubers, and cereals are being fertilized in a few cases, but total fertilizer application to these food crops represents only 10% of 2000A fertilizer use. There are two prefectures, however, where use of fertilizer on beans is an important share of total fertilizer use (19% in both Butaré and Byumba).

Another aspect of fertilizer use patterns concerns the quantities used by individual farmers. Among the small group of farmers using fertilizer in 2000A, 36% used just 1 to 5 Kg and 70% used less than 25 Kg Only 11% of users applied large quantities exceeding 75 Kg In other words, the distribution of fertilizer quantities across users is skewed with a large number of small consumers and a small number of large consumers.

The preponderance of farms making small purchases does not necessarily mean low application rates per hectare because typical farm sizes in Rwanda are very small (54% < 0.5 hectares) as are the particular fields being fertilized. The average rate of application among farmers using fertilizer was 118 kg/ha with prefecture averages ranging from a low of 2 kg/ha in Kigali Rurale to a high of 269 kg/ha in Byumba. This effective rate of application is in sharp contrast to the average national rate of fertilizer use during 2000A, which was only 6 kg/ha.

Information presented on current patterns of fertilizer use suggest that there is substantial potential for increasing fertilizer use by increasing adoption rates (currently only about 5% of farmers using fertilizer per year) as well as increasing the spread of fertilizer across cultivated land (currently about 3% of cultivated area but rising to approximately 20-30% of area for crops such as potatoes, vegetables, and rice that have good market potential). Given that farmers now using fertilizer are few in number and are using fertilizer at relatively high rates of application per hectare (118 kg/ha on average), there is much greater scope for increasing aggregate fertilizer consumption by increasing the number of adopters and the spread across cultivated land than by increasing application rates. Nevertheless, the relatively high application rate gives us confidence that farmers who are using fertilizer are finding it profitable; were it not profitable they would be unlikely to be using such high doses.

The fertilizer data presented above was collected during the 2000A season but includes information on fertilizer used during the 1999C season. The C season consists primarily of vegetable production in marshlands. We do not yet have survey data for fertilizer consumption in the 2000B season, but there are some major differences in production patterns between the A and B seasons that should result in a slightly different pattern of fertilizer use for 2000B. For example: (1) sorghum is a very minor crop during season A but a major crop in season B, (2) potato production is of equal importance during seasons A and B in Gisenyi but much more important during season B in Ruhengeri, (3) maize production is more important in Season A than in Season B. In other words, a simple doubling of the 2000A fertilizer use patterns is unlikely to provide a good estimate of total annual fertilizer consumption because of changes in the relative importance of key fertilizer using

crops. Once 2000B data has been analyzed we should have a full picture of fertilizer consumption during 2000.

Table 3: Fertilizer Used During 2000A Season (kilograms)

Crops	Butare	Byumba	Cyangugu	Gikongoro	Gisenyi	Gitarama	Kibungo	Kibuye	Kigali R.	Ruhengeri	Umutara	Rwanda	Share
Beans	11,284	64,232	-	-	-	6,390	-	-	-	-	-	81,906	4%
Peas	-	-	-	4,025	-	-	-	-	-	-	-	4,025	0%
Peanuts	-	-	-	-	-	-	-	-	-	-	-	-	0%
Soybeans	-	-	-	-	-	-	-	-	-	-	5,511	5,511	0%
Sorghum	-	-	-	-	25,418	-	-	-	-	-	-	25,418	1%
Maize	4,236	4,565	-	-	-	-	-	-	-	-	-	8,801	0%
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	0%
Eleusine	-	-	-	-	-	-	-	-	-	-	-	-	0%
Rice	-	-	118,078	-	-	-	-	-	1,229	-	-	119,307	6%
Cassava	-	-	-	-	-	11,888	-	-	-	-	-	11,888	1%
Potato	13,541	232,038	-	3,655	563,099	-	-	411	-	6,276	-	819,020	42%
Sw. Potato	564	35,036	1554	367	9,727	-	-	-	-	-	857	48,105	2%
Colocase	-	-	-	-	-	-	-	-	-	-	-	-	0%
Yam	-	-	-	-	-	-	-	-	-	-	-	-	0%
Vegetables	29,583	435	-	604	84,727	-	-	-	-	-	8,267	123,616	6%
Banana	-	408	-	24,054	-	32,933	-	-	1,175	-	15,493	74,063	4%
Coffee	-	-	21,195	-	304,873	81,315	185	-	-	-	857	408,425	21%
Other food	-	-	-	-	-	8,140	-	-	-	-	-	8,140	0%
Tea/indust.	-	-	395	-	33,891	-	-	60,897	1,229	-	-	96,412	5%
Woodland	-	4,596	-	-	-	-	-	-	-	-	-	4,596	0%
Fallow	-	-	-	34,502	73,517	-	-	-	-	-	-	108,019	6%
													0%
Totals (tons)	59,208	341,310	141,222	67,207	1,095,252	140,666	185	61,308	3,633	6,276	30,985	1,947,252	100%
Share	3%	18%	7%	3%	56%	7%	0%	3%	0%	0%	2%	100%	

2.5. Potential for Increased Fertilizer Consumption

The current MINAGRI focus on increasing the adoption of improved inputs is predicated on the belief that current fertilizer consumption is well below levels that could be used profitably by Rwandan farmers. This brings us to review what is known about fertilizer response and profitability in Rwanda and how these factors shape agronomic and agro-economic potential as well as effective demand.

2.1.3. Review of Fertilizer Response Data and Updating of Profitability Analyses

In 1999, DSA/FSRP and FAO collaborated on a study to summarize what was known about fertilizer response in Rwanda and update fertilizer profitability analyses using post-war input and output prices and transportation costs. MINAGRI organized a workshop in December 1999 to discuss these research results and a final report, incorporating additional insights gained from the workshop, was published in February 2000 (Kelly and Murekezi). Although fertilizer response data is generally associated with one of the 18 agrobioclimatic (ABC) zones found in Rwanda, the authors made an effort to map the results of the profitability analyses on an administrative map of Rwanda which identifies the communes where there is potential for profitable fertilizer use on the 11 crops studied: climbing beans, maize, rice, sorghum, Irish potatoes, soybeans, sweet potatoes, peas, wheat, cassava, and cabbage.

Profitability was evaluated by calculating value cost (v/c) ratios, i.e., the value of additional production obtained from using fertilizer divided by the cost of the fertilizer treatment. A v/c ratio >2 is generally considered an adequate incentive for fertilizer adoption; it means that the financial returns to using fertilizer are two times greater than the cost.

A major finding of the report was that using a combination of DAP and urea was more profitable than using the NPK fertilizers (17-17-17) that had been recommended in the past. Although there was concern expressed at the workshop about future problems with potassium deficiencies (particularly for tuber crops) if the GOR adopted an official policy of recommending DAP and urea, there was general agreement that agricultural research had shown little response to potassium fertilizers in most ABC zones. To avoid future problems, monitoring soil nutrient levels was recommended for zones using large amounts of DAP and urea so that potassium could be reintroduced when deficient. Also emphasized by workshop participants was the need to combine inorganic fertilizers with adequate quantities of manure (in all zones) and lime (in zones with acid soils) if fertilizer efficiency and profitability were to be achieved and sustained. Among the highlights of the fertilizer profitability findings were:

- Superb potential for fertilization of Irish potato (v/c ratios frequently >8) in about one-fourth of all communes.
- Excellent potential (v/c ratios frequently > 3) for DAP fertilizer used on climbing beans[8] in six ABC zones; these zones are found in approximately one-third of Rwanda's communes;
- Excellent potential for sweet potatoes (v/c for DAP/urea combinations generally >3) in about one-fifth of communes;
- Good potential on sorghum (v/c ratios from 2-4) in 4 ABC zones representing about one-fourth of communes.

[8] Fertilizer response is poor on traditional dwarf varieties of beans and not recommended.

- Good potential (v/c ratios generally 2-3) for maize in five ABC zones represented in at least one-third of the communes;

For all of the above crops, it is possible that fertilizer could be used profitably in a wider range of zones and communes, but this cannot be determined without access to additional agronomic research on fertilizer response in these zones.[9]

Fertilizer use was found to be profitable on irrigated rice, horticultural crops such as cabbage and on inoculated soybeans in a limited number of ABC zones for which agronomic research results were found. More agronomic research results are needed to make recommendations for these crops over a wider range of ABC zones.

Fertilizer use on peas, cassava and wheat was clearly unprofitable and not recommended given prices prevailing during the 1995-1999 period.

The report and workshop did not deal with coffee and tea–export and industrial crops for which fertilizer imports and use tend to be managed by the industries themselves.

In sum, the updated profitability analyses confirmed that there is substantial potential for profitably increasing fertilizer use in Rwanda while simultaneously identifying some crop/zone combinations where fertilizer is not profitable and should be avoided.

2.1.4. Estimating Agronomic and Agro-Economic Potential for Fertilizer Use

Developing an understanding of fertilizer potential and demand can be broken into three components:

(1) Estimating the agronomic potential;
(2) Estimating the agro-economic potential;
(3) Estimating effective demand.

The first step of estimating the agronomic potential involves identifying the maximum amount of fertilizer that could be used if farmers applied fertilizer on all cultivated land up to the point where an additional kilogram of fertilizer would result in a reduction rather than an increase in yields. In estimating agronomic potential, profitability of fertilizer use is not a consideration.[10] In Rwanda there have been various attempts in the past to estimate what has been referred to as 'theoretical demand'. These estimates come close to what is implied by agronomic potential, but they are generally based on fertilizer doses at the point on the production function where marginal yields begin to decline rather than the point where total yield begins to decline (i.e., 'theoretical demand' is a more conservative estimate than agronomic potential).

Table 4 summarizes key characteristics of three estimates of 'theoretical demand' for Rwanda found in the literature. One such estimate, developed in 1987 and projected forward reported a 'theoretical demand' of 435,700 tons of fertilizer for the year 2000. Other analysts have reported estimates of

[9] It is possible that some of this research has already been carried out (e.g., rice response outside of the Butaré area) but the documentation was not available at the time the Kelly and Murekezi study was conducted.

[10] This is equivalent to the point on the production function where the curve starts to decline (end of stage II).

about 65,000 tons for 1989 and 272,000 tons for 1992. A weaknesses in these estimates is that Rwanda has not conducted fertilizer trials and demonstrations for the full range of crop/zone combinations that farmers are cultivating; consequently, results from zones where trials have been conducted are assumed to be valid in zones where no research has been undertaken. This can lead to over- or under-estimates of fertilizer potential. In our opinion, estimating agronomic potential or 'theoretical demand' in the manner described above does little to contribute to our understanding of effective demand, which is really the most important estimate that needs to be made in a country attempting to build a private sector fertilizer market.

Table 4: Approximations of Agronomic Potential from Earlier Studies

Source	Theoretical Demand (tonnes)	Year	Cultivated (hectares)	Crops	Observations
CNA 1991	65,025 (53 kg/ha)	1989	1,216,200	Climbing beans, soybeans, barley, potatoes, sweet potatoes, tea, coffee	Fertilizer rates ranging from 100-400 kg/ha (64-175 kg/ha of nutrients).
CNA 1991	435,700 (284 kg/ha)	2000	1,529,193	Banana, all beans, peas, soybeans, groundnuts, maize, sorghum, wheat, rice, cassava, sweet potatoes, Irish potatoes, tea, coffee, and sugar	Projection based on 1987 cultivated area assumed to grow at 3%/year. Fertilizer rates ranging from 100-500 kg/ha.
Kayitare 1997 citing FAO 1995	271,915 (232 kg/ha)	1992	1,169,200	Same food crops as above but no tea, coffee, or sugar	Fertilizer rates ranging from 100-400 kg/ha.

Note: See text for definitions of agronomic potential and "theoretical demand".

Estimating the agro-economic potential brings us a step closer to understanding the upper limits of effective demand. Agro-economic potential is determined by assuming that all land is cultivated using financially optimal fertilizer doses. Financially optimal fertilizer doses are determined by the point where the marginal returns to an additional kilogram of fertilizer are equal to the marginal cost of that fertilizer; this is also referred to as the profit maximizing point. Some analysts have made estimates of 'theoretical demand' for Rwanda that have been conditioned by economic considerations. The most common technique has been to estimate 'theoretical demand' for only those crops showing a v/c ratio >2 at the time of the analysis. One such estimate, using 1987 prices and projecting area cultivated and 'theoretical demand' to the year 2000, reported a 'theoretical demand' (roughly equivalent to agro-economic potential) of about 160,000 tons (CNA 1991).[11]

It is our opinion that if estimates of agro-economic potential are to provide useful information to policy makers and fertilizer importers, we need to employ stricter criteria than those used in the past to identify crop/zone combinations where there is agro-economic potential for fertilizer use. The

[11] Using the v/c>2 criteria will produce an estimate of 'theoretical demand' that is lower than agro-economic potential as defined above (in the case of agro-economic potential the v/c would be 1).

recent updating of fertilizer profitability analyses provides a point of departure for building national estimates. Estimates completed to date are partial as they cover only seven crops: sorghum, maize, Irish potatoes, soybeans, sweet potatoes, vegetables, and climbing beans.[12] Unlike earlier estimates of 'theoretical demand' that have assumed agronomic results from one ABC zone can be imputed to other ABC zones, we follow a strict rule of estimating agro-economic potential for only those crop/zone combinations that have direct evidence from within the zone that fertilizer use is profitable. The third important criterion is that our cut-off for profitability is a v/c ratio ≥ 3. This is a more conservative measure of profitability than the v/c ratio ≥2 used in Kelly and Murekezi to identify crop/zone combinations where fertilizer should be promoted. A ratio of 3 rather than 2 is selected here because it provides a margin of protection against changes in profitability associated with changes in prices that have taken place since the v/c ratios were estimated in 1999.[13] We assume that recommended doses of fertilizer will be applied to all land that is located in appropriate ABC zones and cultivated in these seven crops. Area cultivated by crop and zone was estimated by combining 2000A and 2000B survey data on cultivated areas with information from Berdinger (1993) on percent of land in each prefecture falling into each ABC zone.[14] Estimates thus far cover only 16% of total area cultivated during the 2000A and B seasons (Table 5). The poor coverage is due primarily to a lack of response data covering all the ABC zones where these crops are grown.

[12] We also attempted to estimate potential for rice fertilizer but response data are available for only a small area in Butaré making it impossible for us to get a reasonable estimate because the 2000A and B survey data, collected to accurately estimate national production, do not provide accurate rice area data at the prefecture and zone level.

[13] See Table 7 below for input/output ratios reflecting relative changes in fertilizer and output prices.

[14] For example: Potato fertilizer is profitable in ABC zone 5c. In Gisenyi 21% of cultivable land is in zone 5c and there were 24,022 ha of cultivated potatoes grown in seasons 2000A and B. The area for which we estimate an agro-economic potential is total cultivated potato area * share of total area in zone 5c (24,022*.21=5,045 ha). This method is based on an implicit assumption that potato cultivation is distributed relatively equally throughout the prefecture. Given that most Rwandan farmers do not specialize, generally producing a mix of 3-5 crops during season A and 5-9 crops during season B, this is not an unreasonable assumption.

Table 5: Cultivated Area Covered by Estimates of Agro-Economic Potential for Fertilizer

Crop	Total Hectares Cultivated	Hectares w. Fert. Potential	Fertilizer Potential Coverage
Beans	319,429	23,954	7%
Maize	89,395	2,633	3%
Sorghum	196,697	42,751	22%
Irish Potatoes	78,628	47,775	61%
Soybean	9,338	2,371	25%
Sweet Potatoes	189,988	21,693	11%
Vegetables	8,660	386	4%
Total	892,135	141,562	16%

Source: Calculated using DSA/FSRP 2000 A/B area estimates, Berdinger 1993 estimates of area in ABC zones, and Kelly/Murekezi 2000 v/c ratio estimates.

Table 6 shows our partial estimate of agro-economic potential based on the seven crops and 16% of cultivated area covered. Neither the relative importance of the crops fertilized nor the ranking of prefectures by quantities of fertilizer reflect patterns exhibited in the 2000A survey data (Table 3). This can be expected to a certain degree given that Table 6 is an estimate for 2000A and B while Table 3 covers only 2000A. One of the more striking results in Table 6 is that the agro-economic potential for sorghum fertilizer appears to be as great as that for potatoes (7473 tons for the former and 7856 tons for the latter). Sweet potato fertilizer ranks third (3548 tons). In Table 3 there was very little application of fertilizers on both sorghum (1% of total use in 2000A–a season with little sorghum production) and sweet potatoes (2% of total use in 2000A). Although these crops should respond to fertilizer use in a profitable manner, our hypothesis is that Rwandan farmers, who are relatively new adopters, tend to fertilizer more commercial crops and also prefer to use fertilizer on the crops that have the highest potential for profitability (i.e., v/c ratios >8 such as those estimated for Irish potatoes). Once farmers have gained experience with the 'starter crops,' fertilizer use should spread to less profitable or less commercial crops. There was some evidence of this in Table 3 for Gisenyi where fertilizer was used in fairly large quantities on seven crops.

Another noticeable difference between 2000A consumption and agro-economic potential is that Gisenyi, which consumed more fertilizer than all other prefectures combined in 2000A, falls behind in terms of agro-economic potential. Kigali Rurale takes the lead with Ruhengeri second and Gisenyi third. It is the large increase in sorghum fertilizer that moves Kigali Rurale into the lead. For Ruhengeri, Irish potatoes make the difference.

Our desire is to improve this estimate of agro-economic potential as more data become available. The first step will be to add estimates of agro-economic potential for lime; this will be particularly important in regions of acid soils such as Gikongoro where fertilizer is not profitable without lime. Estimating the need for organic fertilizers (manure) will also be important as this will provide a basis for assessing whether the current supply of animals can produce the quantity of organic supplements needed to ensure profitable fertilizer response. The next step could be to add the principal export and industrial crops (coffee and tea) for which we need both agronomic response data and more precise

area data. Rough estimates of agronomic potential for these crops and perhaps agro-economic potential may be available from OCIR Thé, and OCIR Café.[15] A final step will be extending the estimates to ABC zones for which we do not yet have good agronomic response data[16] For example, 2000A survey data shows that vegetables are being grown in all prefectures and that they are frequently fertilized, but we only have fertilizer response data permitting us to estimate agro-economic potential for vegetables grown in the low-lands of one ABC zone (*Plateau de Sud*). Rice presents a similar problem as does sorghum in Gisenyi (a prefecture currently using fertilizer on sorghum but for which we have no recommendations).

In sum, with this very partial estimate of agro-economic potential based on more conservative criteria than are commonly used for such estimates, our results show that (1) agro-economic potential is at least three times greater than current imports and utilization (22798 tons potential vs. 6-8000 tons imported in 2000) and (2) estimated cultivated area where fertilizer is known to be profitable is more than 5 times the area currently fertilized (16% of cultivated area showing potential vs. only 3% currently fertilized).

[15] Using figures of the 1999 OCIR Café census of coffee trees, we found the agronomic potential for coffee fertilization to be 20, 313 tonnes per year using NPK 20.10.10 or 12,188 tonnes per year using urea 46% plus manure and mulching. OCIR Thé estimates using 10,700 tonnes per year using the recommended fertilizer applications.

[16] Of concern here are all the grey and white areas of the maps in Kelly and Murekezi. It is possible that there are fertilizer response data from earlier research that were not found at the time of the Kelly and Murekezi study; if this is true, the process of expanding the recommendations will be more rapid if we find these studies than if new research is needed.

Table 6. Agro-economic Potential for Beans, Maize, Sorghum, Irish Potatoes, Soybeans, Sweet Potatoes and Vegetables (Metric Tons)

Crop	Zones	Butare	Byumba & Umutara	Cyangugu	Gikongoro	Gisenyi	Gitarama	Kibungo	Kibuye	Kigali R.	Ruhengeri	Total
Beans		**164**	**139**	**103**	**34**	**410**	**990**	**45**	**-**	**91**	**936**	**2,912**
	1	-	-	103	-	-	-	-	-	-	-	103
	4B	109	-	-	34	-	-	-	-	-	-	143
	4C	55	-	-	-	-	815	-	-	80	-	950
	4F	-	139	-	-	-	-	37	-	11	-	187
	5C	-	-	-	-	410	175	8	-	-	936	1,528
Maize		**-**	**-**	**553**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**553**
	2A	-	-	367	-	-	-	-	-	-	-	367
	2B	-	-	186	-	-	-	-	-	-	-	186
Sorghum		**-**	**742**	**-**	**-**	**-**	**294**	**1,362**	**-**	**4,931**	**144**	**7,473**
	4D	-	742	-	-	-	294	129	-	2,155	144	3,464
	6A	-	-	-	-	-	-	1,233	-	2,776	-	4,009
Irish Potatoes		**64**	**477**	**-**	**586**	**2,525**	**-**	**160**	**981**	**67**	**2,995**	**7,856**
	2A	-	-	-	-	-	-	-	-	-	-	-
	2B	-	-	-	-	-	-	-	-	-	-	-
	4C	45	-	-	-	-	-	-	-	29	-	74
	5A	19	-	-	579	1,764	-	112	422	-	84	2,979
	5B	-	477	-	7	20	-	1	559	38	1,784	2,887
	5C	-	-	-	-	741	-	47	-	-	1,127	1,915
Soybeans		**135**	**5**	**33**	**9**	**-**	**137**	**5**	**-**	**20**	**-**	**344**
	2A	-	-	33	-	-	-	-	-	-	-	33
	4B	90	-	-	9	-	-	-	-	-	-	99
	4C	45	-	-	-	-	104	-	-	3	-	152
	4D	-	5	-	-	-	33	5	-	17	-	60
Sweet Potatoes		**1,123**	**293**	**-**	**273**	**-**	**550**	**127**	**-**	**1,116**	**65**	**3,548**
	4B	1,123	-	-	273	-	-	-	-	-	-	1,396
	4D	-	293	-	-	-	550	127	-	1,116	65	2,152
Vegetables*	**4B**	**99**	**-**	**-**	**13**	**-**	**-**	**-**	**-**	**-**	**-**	**112**
Total Potential		**1,584**	**1,657**	689	916	2,934	1,972	1,699	982	**6,225**	**4,140**	**22,798**

Source: Estimated by authors (see text for details)

Notes: Estimates assume that all land in crop/zone combinations with v/c ratio>3 receive the recommended dose of fertilizer.

* Cultivated area for vegetables available from 2000A/B data does not generally fall in ABC zones for which we have agro-economic analyses indicating that these crops can use fertiliser profitably. The agro-economic potential for vegetables is very likely much greater than what is estimated here, but we need response data for ABC zones where the crops are currently being cultivated to be sure that fertiliser use would be profitable.

2.1.5. Effective Demand: Determinants and Estimates

Effective demand is the quantity of fertilizer that farmers would be willing to purchase if it were available. Estimating effective demand is the most challenging task, particularly in the Rwandan context where there has been very little fertilizer used in the past and most of that was distributed through government services or relief programs at subsidized rates. An understanding of the relative importance of various factors that influence fertilizer purchasing patterns contributes to our ability to design policies that will stimulate fertilizer demand.

Determinants of Fertilizer Demand: Farmers' Views of Constraints

What do we mean by determinants of fertilizer demand. Determinants of effective demand can be divided into two broad groups: incentives and capacity. Incentives are primarily viewed as economic incentives that are summarized in indicators of fertilizer profitability such as the v/c ratios discussed above and determined by fertilizer response, fertilizer prices, and output prices. The updated fertilizer profitability analyses by Kelly and Murekezi showed that there were strong incentives (many v/c ratios >3) to use fertilizer in Rwanda for a broad range of crop/zone combinations. Even though there has been some deterioration in input/output price ratios in recent years (Table 7) due to increasing fertilizer prices and declining output prices, these changes have not been dramatic enough to result in unprofitable use for all crop/zone combinations reported in Kelly and Murekezi that had v/c ratios >3 in 1999. If profit incentives exist but farmers are not purchasing fertilizer it may be due to an inadequate supply of fertilizer or to a variety of capacity constraints.

Table 7: Fertilizer Input/Output Price Ratios for 1998 and 2000 Compared

Fertilizer Price	1998		2000	
	Low 176 f/kg	High 200 f/kg	Low 220F/kg	High 250F/kg
I/O Ratios				
Rice	0.7	0.8	1.0	1.1
Soybeans	0.7	0.8	1.4	1.6
Beans	1.0	1.2	2.2	2.5
Maize	1.4	1.6	2.6	3.0
Sorghum	1.27	1.4	2.7	3.0
Irish Potatoes	1.8	2.0	6.0	6.8
Sweet Potatoes	3.0	3.4	7.6	8.7
Cabbage	2.2	2.5	8.8	10.0

Source: Calculated from PASAR market price data.

Note: The i/o ratio is the number of kilograms of output needed to purchase one kilogram of fertilizer.

Inadequate supply really means that the effective cost of fertilizer is much higher than the cost used in calculating v/c ratios. For example, if farmers cannot obtain fertilizer in their communities and must travel long distances to find it, the effective cost of fertilizer increases substantially; the cost becomes infinite if there are no supplies within feasible traveling distance. Inadequate supply reduces the incentives reflected by the v/c ratios as these estimates assume that fertilizer will be available.

Capacity constraints can be subdivided into three groups: human capital, financial capital, and physical capital. For example, if farmers do not know about the economic incentives associated with fertilizer use, there is a human capital constraint that needs to be lifted by improving knowledge. If farmers do not purchase fertilizer because they don't have the financial capital, there is a need to build financial capital through savings and credit programs. If farmers do not purchase fertilizer because they don't have the physical capital to use it properly (anti-erosion investments, animals to provide complementary manure, farming tools and equipment, etc.) then this constraint needs to be addressed for agro-economic potential to be translated into effective demand.

There have not been any national studies of the determinants of fertilizer demand in Rwanda, but we do have some information from farm surveys that helps us better understand the factors that farmers take into account when making decisions about agricultural intensification. We summarize the key findings of these surveys below. One of the challenges in interpreting the results is resolving the apparently conflicting farmer opinions concerning the relative importance of different constraints and what the differences imply for the design of fertilizer promotion policies. We look forward to obtaining additional insights on these issues from conference participants, particularly those working directly with farmers.

Insights from the Birunga Maize Project Zone . A study conducted by Ngirumwami in 1989 as part of a maize promotion project in Birunga assessed farmers' attitudes about increasing maize production by adopting new varieties and fertilizers. The survey interviewed 138 farmers in the project zone, covering two communes in Gisenyi (Mutura and Rwerere) and two communes in Ruhengeri (Kinigi and Nkuli). The project area is one where maize is the principal food crop but Irish potatoes, beans and sorghum are also produced for home consumption by more than 50% of farmers.

Virtually all the farmers (97%) were already producing maize and all claimed they wanted to increase their maize production; but 59% were not willing to do this if it meant expanding maize area at the expense of some other crop (i.e., they were not willing to become more specialized in maize).[17] When asked what factors would stimulate them to use fertilizer on maize, 69% said they would need credit, 15% said they would only do it if fertilizer prices were more favorable, and 14% wanted guaranteed output prices. Note that the most frequently cited stimulus–credit–concerns improved access rather than improved incentives. The 29% mentioning price factors, were still concerned about whether the incentives were adequate.

Among the farmers interviewed, only 28% were marketing some of their current maize production; all others were producing entirely for home consumption. Sales were being made primarily to small assemblers (57% of transactions) and other producers (38%). When asked what they would do with additional production, only 19% claimed they would continue to use everything produced for home consumption; 22% said they would market all increased production and 59% said that increased

[17] This finding is particularly important given that there is a great deal of interest in promoting crop specialization in Rwanda to take the comparative advantage of different ABC zones into account.

production would go to both sales and home consumption. Some concern was expressed about an increase in Rwandan production being able to compete with imports that were coming from Zaire and Uganda. Half the respondents thought that imported maize was selling at lower prices than local maize while 31% thought it was selling at higher prices.

Insights from the 2000A DSA/FSRP survey. DSA/FSRP asked the 88% of farmers who did not use fertilizer from 1995 through 1999 to explain their reasons for not using it. The results are summarized in Table 8, which shows the breakdown of responses by prefecture. Many of the opinions expressed by randomly selected farmers in the DSA/FSRP sample differ from those in the maize survey discussed above, which focussed on farmers in a project zone that had benefited from targeted extension efforts.

Table 8. Reasons Why Farmers Did Not Use Fertilizer From 1995 Through 1999

	Butare	Byumba	Cyangugu	Gikongono	Gisenyi	Gita-rama	Kibungo	Kibuye	Kigale Rurale	Ruhengeri	Umu-tara	Rwanda
	(percentage of non-users)											
Don't know	41	22	78	50	56	84	76	39	27			53
High Price	44	38	13	24	24	9		52	70			30
No Credit	1	3	7	0	4	0		1	1			3
Not Available	10	40	11	21	19	10		0	3			13
Other	5	31	6	6	2	1		8	0			7

Source: MINAGRI/DSA survey data, 2000.

Notes: Percents are based on responses made by the 88% of farmers not using fertilizer from 1995-1999. Some columns total to more than 100% because multiple responses were permitted

Lack of Knowledge Inhibits Fertilizer Use. The most common explanation for non-use (53% of the 88% who were non-users, which represents 47% of all farm households) was that they did not "know" fertilizer. We interpret this response to mean that although they have heard about inorganic fertilizers, their knowledge of the benefits and of how to use the fertilizers was not strong enough to stimulate use. This response was more common in the prefectures of Gitarama, Cyangugu, Kibungo, and Ruhengeri than elsewhere.

Farmers also were asked if they thought that inorganic fertilizers needed to be used with complementary inputs to be effective–another way of assessing farmers' knowledge about fertilizers. The replies indicate that knowledge concerning the complementarity of organic and inorganic fertilizers is fairly strong (68% of respondents indicated that these inputs needed to be used together), followed by knowledge about pesticide use (46% reporting complementarities) and improved seeds (mentioned by 35% of respondents). Complementarities involving fungicides (27%) and compost (22%) were also mentioned. There were differences in the level of response across prefectures that suggest not only differences in the level of knowledge but also differences in needs due to soil characteristics. For example, more than 90% of respondents in Gisenyi and Gitarama recognized the need to combine inorganic and organic fertilizers while the highest mention of the need for lime (31%) came from farmers in Gikongoro, a zone of unusually acid soils. These results suggest that farmers are not as poorly informed about fertilizer use as the results reported in the previous paragraph suggest. Nevertheless, if the goal is to rapidly expand fertilizer use, all potential users need

to understand the importance of using fertilizers in combination with key complementary inputs to ensure profitable results.

High Fertilizer Prices Are A Constraint. The next most common explanation for non-use from 1995-1999 was that fertilizer prices were too high (30% of the non-users or 25% of all farms). Typical farm gate fertilizer prices for the 1995-1999 period were in the 200-260 RwF/kg. range after the subsidy was removed in 1999 and in the 125-200 RwF/kg. range with subsidies. Prices varied by type of fertilizer and transportation costs, which differed across prefectures. High price was mentioned most frequently in Kigali Rural, followed by Kibuye, Butaré, and Byumba.

The 2000A survey asked farmers to provide an estimate of the maximum fertilizer price they would be willing to pay per kilogram for use on selected crops. Table 9 shows that average willingness to pay varied from 131 RwF/kg. for sorghum (a crop rated relatively low by farmers with respect to fertilizer yield response) to 161 RwF/kg. for coffee and vegetables (crops thought to exhibit strong yield responses); these prices are all substantially below those prevailing during the 2000A season (220-250 RwF/kg.) but the variation in willingness to pay across crops suggests that farmers do have better knowledge of fertilizer response and profitability by crop than suggested by the high number of farmers claiming that they 'don't know fertilizer'.

Table 9: Prices Farmers are Willing to Pay for Fertilizer

Crop	Prices Farmers are Willing to Pay for Fertilizer (RwF/kg)	
	National Average	Standard Deviation
Beans	141	77
Potatoes	144	71
Vegetables	161	78
Coffee	161	66
Sorghum	131	77

Source: DSA/FSRP Survey Data 2000A

In most cases, the price of fertilizer alone is a poor indicator of the financial incentive to use the product because fertilizer profitability varies with changes in both the price of fertilizer and changes in the value of the supplemental production attributable to fertilizer use. Because such a small percent of Rwanda's farmers market their production, it is understandable that many currently look at the price of fertilizer in isolation rather than in conjunction with output prices. Nevertheless, as farmers begin the transition from semi-subsistence production to commercial agriculture, they will begin to pay more attention to input/output price ratios and ultimately make their own calculations of v/c ratios. If both of these ratios become more favourable, effective demand for fertilizer will grow.

Inadequate Fertilizer Supply Reduces Access for a Small Group of Farmers. Poor fertilizer supply was mentioned as a constraint by 13% of non-users (11% of all farms). The problem of supply was noted more frequently in Byumba (40% of non-users) and Umutara (45% of non-users). Supply seems to be less of a problem in Kibuye, Kigali Rural, Ruhengeri, and Kibungo where it was cited as a constraint by <5% of non-users (lack of knowledge and prices being more important).

Credit Constraints Seldom Mentioned. Lack of credit was mentioned by a small group of non-users (3%, equivalent to 2.6% of all farms), representing a minor factor in the aggregate picture where lack

of knowledge, high prices, and supply factors predominate. We note that these results differ substantially from those of farmers in the maize project zone where knowledge of fertilizer was no doubt increased by project activities and many farmers (69%) had arrived at the stage of wanting fertilizer but not having the cash flow to purchase it.

Results from a survey of coffee farmers. With coffee being a commercial crop, one would expect to see a high incidence of its fertilization but this is not the case at present in Rwanda. A survey conducted by OCIR café in 1999 found that only 4.7% of coffee farmers used fertilizers. The main reasons cited by the farmers for their non-use of fertilizers was the high cost of fertilizers (52.4% of the farmers), unavailability of fertilizers in the region (47.2%), and inadequate knowledge of fertilizers (23.9%). Complaints about the high costs suggest a need to update fertilizer profitability analyses for coffee (an important gap in the Kelly and Murekezi work).

In sum, the perceived constraint varies depending on the knowledge and experience of farmers. On an aggregate national scale, lack of knowledge appears most important (DSA/FSRP survey results). Although farmers have general notions about fertilizer and how to use it they appear to feel that their knowledge is not sufficient to take the risk of purchasing fertilizer. We believe that references to prices being too high are also related to lack of knowledge–farmers are simply not aware of the numerous opportunities for profitable fertilizer use at prevailing input/output prices. Among farmers with better knowledge of fertilizer (e.g., those in the maize project zone or coffee producers), credit and supply issues become important.

A Partial Estimate of Effective Demand

As noted above, we do not have adequate data on past fertilizer consumption patterns to accurately estimate effective demand for fertilizer. We have, however, developed a set of assumptions about how farmers are likely to respond to crops with different levels of predicted profitability and used these assumptions to see if we can estimate a demand for crop/zone combinations covered by the Kelly and Murekezi analysis. As noted earlier, this is a very partial estimate of effective demand because it does not attempt to estimate demand for crop/zone combinations where there is no direct evidence of fertilizer response and profitability (i.e., primarily the grey and white area of the maps in Kelly and Murekezi). In effect, our estimate can be considered a minimum effective demand for 16% of cultivated area, given prevailing prices and farmers' knowledge of fertilizer. The key assumptions used in the estimate are that:

(1) Farmers will fertilizer all land planted in maize, sorghum, beans, Irish potatoes, soybeans, vegetables and sweet potatoes that is located in the ABC zones where the estimated v/c ratio is ≥3;

(2) The dose used will be less than the recommended dose:
if v/c ratios are 3-4.9 the dose will be 10% of recommendations;
if v/c ratios 5-9.9 the dose will be 30% of recommendations;
if v/c ratios are ≥10, the dose will be 75% of recommendations.

The logic underlying these new assumptions is that the greater the potential returns to fertilizer use the greater the demand by farmers who are just learning to use fertilizer.[18] Using these assumptions we obtain a partial effective demand of 7,941 tons/year for the seven crops covered in the analysis (Table 10). The amount is one that seems reasonable in the current Rwandan context, and the estimates by crop and prefecture better reflect current consumption patterns than the estimate of agro-economic potential reported in Table 6. Interestingly, Ruhengeri now comes out as the leader due to use of fertilizer on potatoes. Kigali Rurale falls behind both Gisenyi and Ruhengeri because most of the potential sorghum area has v/c ratios <5.

This is a very rough and partial estimate of effective demand based on some very simple assumptions. It is presented as a point of departure for discussions on the amount of fertilizer that could be absorbed by Rwandan farmers given current prices and farmers' knowledge of fertilizer. If farmers now using fertilizer on these five crops realize good profits, fertilizer demand could grow rapidly, first arriving at the estimated level of agro-economic potential for these crops (22798 tons annually) and then surpassing it as researchers as well as farmers working on their own identify new crop/zone combinations where fertilizer can be used profitably.

The short-run challenge is figuring out how to rapidly turn agro-economic potential into effective demand. Given the very low levels of adoption (about 5% of farmers), very low spread (3% of land receiving fertilizer), and the very low fertilizer application rates (4 kg/hectare on average), relatively small increases in total adoption and spread could result in doubling and tripling fertilizer consumption. For example, moving from 5 to 10% adoption, if new adopters used about the same quantities of fertilizer as current adopters, could double season A consumption from the approximately 2000 tons used in 2000A to 4000 tons for a single season. As noted above, it appears unlikely that efforts to increase the rate of application currently used by farmers will have much effect on increasing aggregate fertilizer consumption.

At present, the most logical approach for promoting fertilizer seems to be to increase the rate of adoption. Thus far we have two clues drawn from current fertilizer consumption patterns and farmers' opinions that suggest ways of targeting programs to increase adoption rates:

- Fertilizer use is greater on crops with higher v/c ratios and/or dependable markets;
- Fertilizer use could be increased in selected areas by reducing the supply constraint

The supply constraint appears to be most important for coffee farmers and in the prefectures of Umutara and Byumba.

Another clue we have concerning means to increase the spread of fertilizer (i.e., area covered) comes from the maize survey:

- 69% of farmers in a maize intensification project zone identified credit as a constraint to intensifying production.

[18] These assumptions produce the same results as assuming that only 10%, 30%, and 75% of the land cultivated in these crops would be fertilized.

Table 10. Estimated Fertilizer Demand for Beans, Maize, Sorghum, Irish Potatoes, Soybeans, Sweet Potatoes and Vegetables (Metric Tons)

Crop	Zones	Butare	Byumba & Umutara	Cyangugu	Gikongoro	Gisenyi	Gitarama	Kibungo	Kibuye	Kigali R.	Ruhengeri	Total
Beans		**38**	**42**	**10**	**10**	**41**	**99**	**12**	**-**	**11**	**94**	**357**
	1	-	-	10	-	-	-	-	-	-	-	10
	4B	33	-	-	10	-	-	-	-	-	-	43
	4C	5	-	-	-	-	82	-	-	8	-	95
	4F	-	42	-	-	-	-	11	-	3	-	56
	5C	-	-	-	-	41	17	1	-	-	94	153
Maize		**-**	**-**	**56**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**55**
	2A	-	-	37	-	-	-	-	-	-	-	37
	2B	-	-	19	-	-	-	-	-	-	-	19
Sorghum		**-**	**742**	**-**	**-**	**-**	**294**	**1,362**	**-**	**4,931**	**144**	**7,473**
	4D	-	742	-	-	-	294	129	-	2,155	144	3,464
	6A	-	-	-	-	-	-	1,233	-	2,776	-	4,009
Irish Potatoes		**28**	**358**	**-**	**440**	**1,893**	**-**	**120**	**737**	**37**	**2,246**	**5,858**
	2A	-	-	-	-	-	-	-	-	-	-	-
	2B	-	-	-	-	-	-	-	-	-	-	-
	4C	14	-	-	-	-	-	-	-	9	-	22
	5A	14	-	-	434	1,323	-	84	317	-	63	2,235
	5B	-	358	-	6	15	-	1	420	28	1,338	2,165
	5C	-	-	-	-	555	-	35	-	-	845	1,436
Soybeans		**23**	**3**	**3**	**1**	**-**	**56**	**4**	**-**	**13**	**1**	**104**
	2A	-	-	3	-	-	-	-	-	-	-	3
	4B	9	-	-	1	-	-	-	-	-	-	10
	4C	14	-	-	-	-	31	-	-	-	1	46
	4D	-	3	-	-	-	25	4	-	13	-	45
Sweet Potatoes		**112**	**88**	**-**	**27**	**-**	**165**	**38**	**-**	**335**	**20**	**785**
	4B	112	-	-	27	-	-	-	-	-	-	140
	4D	-	88	-	-	-	165	38	-	335	20	646
Vegetables*	**4B**	**30**	**-**	**-**	**4**	**-**	**-**	**-**	**-**	**-**	**-**	**34**
		38	**42**	**10**	**10**	**41**	**99**	**12**	**-**	**11**	**94**	**357**
Total Potential		-	-	10	-	-	-	-	-	-	-	10

Source: Estimated by authors (see text for details)

Notes: Estimates assume that all land cultivated in crop/zone combinations known to have v/c ratios >3 receive following shares of recommended doses:v/c ratios 3-4.9 receive 10% of dose; v/c ratios 5-9.9% receive 30%; v/c ratios =>10% receive 75% of recommended dose.

* Cultivated area for vegetables available from 2000A/B data does not fall in ABC zones for which we have agro-economic analyses indicating that these crops can use fertilizer profitably. The agro-economic potential for vegetables is very likely much greater than what is estimated here, but we need response data for ABC zones where the crops are currently being cultivated to be sure that fertilizer use would be profitable.

This suggests that once farmers become aware of the yield increasing potential of fertilizers through exposure to targeted extension programs, fertilizer credit is cited more frequently as a constraint than by farmers such as those in the DSA 2000A survey who are randomly selected and unlikely to have as good knowledge of fertilizer potential. The latter group tends to indicate that lack of knowledge or price is the constraint, seldom mentioning credit.

Increasing adoption among farmers who report lack of knowledge and/or prices as constraints can be addressed by improvements in extension efforts. The issue of developing effective extension services in Rwanda is too broad and too controversial to be adequately addressed here, but it is clear that the extremely limited MINAGRI budget (approximately 2% of the national budget in 1999) during the past several years has made it very difficult for extension personnel to interact directly with a large number of farmers.[19]

The farmer training program pursued by the MINAGRI during the past two years has informed model farmers about fertilizers as well as other techniques of agricultural intensification. Thus far the program has provided approximately 4500 farmers (30 per commune) with classroom training. The second phase of the training program is a series of on-farm fertilizer demonstration plots (to begin in the 2000B season) that will permit farmers who have received the classroom training to practice what they have learned about fertilizers and demonstrate the results to others in their communities. The effectiveness of these training programs and demonstration plots needs to be carefully monitored (and adjusted, if necessary) to ensure that farmers are getting increased yields and incomes from the use of fertilizer and that after participation in the training and demonstration plot programs farmers' demand for improved techniques and inputs, particularly inorganic fertilizers, grows. It is believed that once non-users have seen demonstration plots with superior yields, they will gain the confidence needed to try fertilizer for themselves.

Extension needs to work with NGOs and fertilizer retailers to significantly increase the number of fertilizer demonstrations taking place and to ensure that the demonstrations are well monitored. This means demonstration farmers are well-trained and supervised and that data are collected permitting analysis of yields, profitability, and impacts on soil nutrient content.

Given the Kelly and Murekezi profitability results, it is clear that fertilizer price is more of a knowledge problem (i.e., lack of knowledge about potential profitability) than a price problem. Nevertheless, improvements in input/output price ratios will stimulate adoption. It is generally more desirable to accomplish this through reductions in the price of fertilizer than through increases in the output price, particularly when the output is a food product in high demand by food-insecure households. Reductions in fertilizer prices tend to come about through increases in the quantity of fertilizer demanded (which permits suppliers to realize economies of scale) and when fertilizer markets become more competitive (as this drives down the margins of various actors in the input supply chain).

[19] For example, the issue of which institutions (e.g., fertilizer distributors, government, NGOs, primary and secondary school programs, etc.) should provide what types of extension services (e.g. theoretical training, on-farm demonstrations, monitoring and evaluation, etc.) needs to be resolved, taking into account the strengths and weakness of all potential participants (e.g., human resources, financial resources, willingness to collaborate in a joint effort with others, etc.).

2.6. Conclusions

2.1.6. Fertiliser Potential

- The potential for profitable fertilizer use in Rwanda during the next few years is high;
- Conservative estimates covering only 16% of cultivated area suggest current potential for a minimum of 22798 tons per year;
- There is an urgent need to evaluate fertilizer response and profitability for crop/zone combinations not covered by the present analyses so that estimates of agro-economic potential can be made for the remaining 84% of cultivated area.

2.1.7. Converting Potential to Effective Demand

- The most rapid way of ensuring that the fertilizer potential already identified is realized will be to increase the rate of adoption (vs. the spread or the rate of application);
- The more rapidly the rate of adoption increases the faster aggregate demand and imports will increase, thereby promoting lower fertilizer prices through economies of scale and increased competition;
- Improving farmers' knowledge of fertilizer potential and how to use the input appears to be the best way to reach the large share (53%) of non-users who claim they 'do not know fertilizer';
- Non-adopters in zones where fertilizer is already used and available (i.e., the northwest) should be targeted first as it will promote more rapid growth in adoption than no targeting or targeting farmers in zones with little fertilizer experience and poor supply;
- Efforts to improve farmers knowledge must be accompanied by efforts to make sure there is fertilizer supply available where training is taking place;
- Improving supply for farmers who already want fertilizer but can't find it could increase fertilizer consumption among some coffee producers as well as farmers in Byumba and Umutara who complained of supply problems;
- Development of an input credit program is **not** recommended in the short run because (1) the need for credit becomes more critical once adoption has taken place and (2) developing a credit program in Rwanda, where there is no history of one, is likely to be more time consuming and costly than increasing fertilizer demand through growth in the number of adopters.

2.1.8. General Policy and Research Issues

- MINAGRI and its development partners (donors, NGOs, fertilizer suppliers, etc.) need to figure out how to develop an efficient and effective extension program which includes a good monitoring component (who will do what and where);
- MINAGRI should evaluate the pros and cons of moving toward an official policy of promoting DAP and urea in lieu of NPK (it is unofficially moving in this direction via demonstration trials);
- A research program needs to be developed to address the gaps in knowledge about fertilizer response and profitability; this program should develop systematic criteria for evaluating profitability and determining the extent to which results from some zones can be applied to others; GOR needs to decide who will do what and how it will be funded;

- Some focussed studies in zones where fertilizer is already consumed in large quantities should be considered in an effort to learn from these successes (i.e., is it the crop that is driving everything or are there other factors related to farmer characteristics, fertilizer access, etc.).

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3. Impact of Agricultural Extension and Research on the Use of Fertilizer in Rwanda

Results of a Survey Conducted with Public and Private Sector Partners, Non-Governmental Organizations, Agricultural Associations and Farmers

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Low soil fertility is the most limiting constraint affecting agricultural production systems in Rwanda. While demographic population growth in Rwanda has seen no bounds, there has been a general downtrend in agricultural production since the second half of the 1980s, and the food availability per capita is in continuous decline. This overall reduction in the productivity of the agricultural system is the result of a general deterioration of the environment. Each year, tons of surface soil, which provides fertility, erode and there is therefore a progressive reduction in yield.

This tendency has been even further worsened by the decimation of livestock during the period of genocide and massacres of 1994, which has decreased the possibility of applying manure, the traditional method of restoring fertility to the soil after harvest.

Policies implemented over the last few years clearly show the will of the Government of Rwanda to overcome the challenge of food security by promoting growth in agricultural production and incomes of the population through the emergence of market-oriented agricultural production.

One of the most important strategies for arriving at this twofold objective is to intensify agriculture through the use of mineral fertilizers because it is generally understood that this practice occurs everywhere where agricultural production increases. Fertilizers contribute from 55 to 57% in the increase of average yields per hectare in cereal production during the 1970's in developing countries (FAO, 2000).

Along with import and internal distribution systems, research and agricultural extension are among the main factors that favor the use of fertilizers. This paper concentrates on the impact of agricultural research extension on the use of fertilizers in Rwanda.

The use of fertilizers requires the definition of technical standards to guide the farmers in the use of this technology. In this innovative process, research on the use of fertilizers is the first step in providing recommendations on fertilizer formulas to be disseminated. The *Institut des Sciences Agronomiques du Rwanda* (ISAR) runs agricultural research and has research stations or centers in 9 of the 12 prefectures of the country. Extension is carried out by a number of actors who frequently do not know each other. The Extension and Marketing Department (*Direction de la Vulgarisation et de la Commercialisation*, DVC) of the Ministry of Agriculture, Livestock Resources and Forestry (MINAGRI) is responsible for their coordination.

3.1. Background

The importance of research on soil fertilization is pointed out in the "*Plan directeur national de la recherche agricole 1990-2000*'' (National master plan for agricultural research 1990-2000) (MINAGRI, 1990), which indicates that this research program is a priority. The two major goals of the "soil fertility" programme were as follows:

- to master parameters most important in ensuring efficiency in fertiliser use.
- to prepare recommendations that were sufficiently precise and that could be disseminated as quickly as possible, in the different agro-ecological zones, and the most prevalent types of soil, while assuring positive financial results with a minimum of risk.

It is regrettable, however, that this planning effort was not supported by sufficient means to implement program activities. The first period of the 1990-2000 national agricultural research plan was dominated by the war, genocide, and instability that strongly affected ISAR capabilities. Also, current revitalization of ISAR research activities on mineral fertilizers does not consider the real needs of farmers in relation to the use of fertilizers and therefore, the impact of research on this subject is negatively affected.

However, long-term development of research work (1980-1993) on the recommendations on fertilizer formulas has made up for the research difficulties. Summary studies of results (Kelly and Murekezi, February 2000) currently allow the use of mineral fertilizers with the assurance of profitable yields from a wide range of crops in several agro-bio-climatic areas.

The results of agricultural extension of fertilizers will be even more evident and convincing when it is based on the development of research that considers the evolution of the profitability of fertilizer use in terms of yield and current market prices. Agricultural research has been in a crisis over the last 10 years but agricultural extension has always suffered from structural deficiencies, which have to be recognised first, before finding a way to overcome them.

Before the 1980s, there were numerous agricultural projects that were often criticized because of their disorderly extension. The following constraints were indicated in relation to agricultural extension (MINAGRI, Conclusions du deuxième séminaire national sur la vulgarisation agricole, 1987) (MINAGRI, Conclusions of the second national seminar on agricultural extension):

- The low number of extension agents, generally recruited on site (MONAGRI) or with insufficient basic education ("A3" agronomists). They were trained to disseminate simple messages, but were not able to understand the problems of the farming environment or to provide useful information that could be applied to agricultural research.

- The difficulty of researchers to become interested in farmes' concrete problems.

- The impossibility of widely scattered farmers to voice their problems and engage in a participative dialogue with extension agents.

At that time, the government and others involved in agricultural research and extension believed that the natural soil fertility in Rwanda was sufficient to assure agricultural production growth. However,

eventually this policy could no longer respond the food needs of a rapidly growing population (3.7 % during 1978 – 1991.)

Toward the middle of the 1980's, MINAGRI, aware of the deterioration of soil productivity, included the use of mineral fertilizers in the agricultural extension programs, supporting agricultural projects designed to introduce this technology in farm work. The "training and visits system" became the national system of extension. This system, which included regular contacts between the extension agent and the farmer could have favored the quick adoption of the mineral fertilizer technology, but the disseminators remained convinced of a vision of agricultural growth based on the exploration of the natural potential of soil fertility and recycling of organic material, while the combination with mineral fertilizers would have improved yields considerably.

The following recommendation from the first national seminar on soil fertilization in Rwanda: "To introduce, prudently and progressively, the dissemination of knowledge already acquired in terms of fertilization into education and into the national system of extension" (MINAGRI, June 1985), is a good expression of the state of mind that prevailed at the time on the use of fertilizers. The impact of agricultural extension on the use of fertilizers, nevertheless, was considerable during 1981 – 1991, when the use of mineral fertilizers was introduced for food crops. In addition, total use of fertilizers on food crops and non-food crops increased from 420 tons in 1981 to 6,592 tons in 1991 (Murekezi, May 2000). The use of fertilizers during this 10-year period rose fifteen-fold.

During 1997-1998, in the context of the preparation of a new strategy for agricultural development, the government defined a new "participative and differentiated" approach to agricultural extension (MINAGRI, March 1998), which recommended a close link between agricultural extension and research. This approach also implied the presence of several actors in the field (researchers, extension agents, farmers associations, NGOs, the private sector) in planning, execution, follow-up and assessment of training and extension activities, as well as research and development.

The involvement of all partners in research, extension, research, and development promotes sharing of information and favors harmonising activities related to the use of fertilizers in Rwanda. Unfortunately, this new participative extension system has not yet been completely accepted by partners in the field, resulting in the reduced impact of agricultural research and extension on the use of fertilizers.

Meanwhile, potential demand is real, even though it is at a very low level. Fertilizers began to be used again in small amounts after the war and genocide in 1994, but the 1991 level has already been reached. The distribution of mineral fertilizers in Rwanda has increased from 2,423 tons in 1995 to 6,064 tons in 1999 (Murekezi, May 2000).

3.2. Methodology

The methodology applied to measure the impact of agricultural extension and research regarding the use of mineral fertilizers consisted of obtaining information through interviews, with 39 partners most involved in fertilization programs and from both the public and private sectors, non-governmental organizations (NGOs), farmers' cooperatives and associations, and individual farmers.

The sample surveyed in this research consisted of a group of partners involved in research and/or extension activities on the use of fertilizers in 9 of the 12 prefectures in Rwanda. This sample does not include rural households of the prefectures selected, contrary to the methodology used by the Food Security Research Project (FSRP.) Instead, we preferred the institutions that represented research services and that were involved in dissemination efforts on fertilization, as well as farmers groups, and NGO's emphasizing the use of fertilizers.

The interviews covered the following: 2 Central Administration Services, 3 Offices, 7 Regional Agricultural Service Departments (*Départements Régionaux des Services Agricoles*, DRSA), 1 commune-level agronomist, 6 agricultural projects, 5 national NGOs, 2 international NGOs, 7 farmers associations or cooperatives, 3 individual farmers, and 3 private sector operators.

The identity of the 39 persons interviewed, as well as their geographical distribution can be found in annexes 1 and 2. The geographical location of the partners' research and/or extension activities allowed the allocation of their activities to Rwandan agro-bio-climatic zones as designated by Gasana (1991).

The interviews were conducted by the consultant himself or by his assistant (Mme Josepha Mukamana) using a questionnaire that concentrated on the following:

- the type of research or extension activity concerning fertilizers.
- the type of fertilizer used by each.
- extension methods for the use of fertilizers.
- sharing of information on the use of fertilizers among the different partners interviewed.
- basic constraints that limit the impact of fertiliser extension and research in Rwanda.
- the implications of policies to enact to overcome constraints identified.

Finally, the interviews were completed with documentary research on the institutional relationships among the different partners interviewed, agricultural research and extension policies implemented by the Government of Rwanda over the last few years, and current activities by different partners related to research and extension on the use of fertilizers, all with the aim of increasing the impact of policies and activities on the use of fertilizers in Rwanda.

3.3. Identification of Partners by Type of Activity Related to Fertilizers

Before analyzing the impact of agricultural extension and research on the use of fertilizers in Rwanda, it is first necessary to identify the different partners interviewed by type of activities that are the object of this study (research, extension and the development of research, as well as training related to fertilizers.) The classification of different partners visited, by type of activity related to fertilizers, follows in table 1.

Table 1: Identification of Partners by Type of Activity Related to Fertilizers

Activity Partner	Research	Research & development	Extension & Training
Public operators (19)	2	3	15
NGOs (7)	-	-	7
Farmers' associations/cooperatives (10)	-	-	2
Private-sector operators (3)	-	-	-

N.B: The numbers in brackets indicate the number of persons interviewed

The following can be deduced from table 1:

- Two public-sector operators (ISAR and FSRP) are involved in research and studies on the use of fertilizers, but cooperation by other partners in these tasks is practically non-existent. ISAR, which is the main institution in charge of agricultural research in general, and research on fertilizers in particular, does not currently have the human, material or financial resources to carry out its mandate. It has been strongly affected by the war, genocide and massacres of 1994. This institution, which currently has 9 research stations in 9 prefectures of the country, only works in 3 of the 18 agro-bio-climatic zones. The work under way at ISAR targets of crops for which previous research has already shown the profitability of fertilizers (pole beans in area 4B: Southern Plateau), or crops for which fertilizers are not favorable under current market conditions (wheat in areas 5A and 5B: Hautes Terres (Highlands) of Bufundu and Hautes Terres (Highlands) of Buberuka).

- Although the research & development program on fertilizers is part of the action plan for 6 agricultural projects (public partners) only 3 projects are really involved in the program:

    - The FSRP Project, associated with the DVC and MINAGRI's Department of Rural Engineering and Soil Conservation are performing 480 fertiliser demonstration trials for five crops (pole beans, corn, potatoes, sorghum, and soya beans) in 28 Rwandan communes, covering seven agro-bio-climatic areas of the country (2A, 4B, 4D, 5A, 5B, 6A) during the 2001B season (DVC/FSRP/GRCS, September 2000). Unfortunately, this dynamic R&D process is not supported by complementary work by ISAR.

    - The Buberuka Rural Area management Project (*Projet de Gestion des Espaces Ruraux de Buberuka*, PGERB) is involved in the development of research in the prefecture of Ruhengeri in close collaboration with ISAR.

    - The Butare Rice Cultivation Project (*Projet Rizicole de Butare*, PRB) has started R&D on the use of fertilizers applied to rice crops during the 2001B season. The fertilizer trials will be carried out with recommended applications of fertilizer in Mayaga (area 6B) as a demonstration to farmers of fertilizer profitability. These trials will also be able to determine the residual amounts of fertilizer that can be used

at the end of the season. PRB agents, with the participation of ISAR researchers will be in charge of follow-up.

- To have a real impact on fertilizer use by farmers, these links between agricultural research and the two projects could be extended to all field projects. It is this R&D activity that provides quick information about the fertiliser profitability in the areas where recommendations about fertilizer formulas for adapted cultivation still lack. Meanwhile, this tight collaboration with ISAR will not be effective if the operational skills of the institution are not strengthened.

- All the NGOs and 15 of 19 public operators are involved in the extension and training on the use of fertilizers. The participation of NGOs in the use of fertilizers is paramount in the current context in Rwanda to supplement the weak capabilities of the public sector in the field. The wide geographical distribution of NGOs, especially in the Prefectures of Butare, Kigali Rural, and Gitarama (Bingen, Mpyisi et Nkeshimana), their facility in mobilizing resources, and the technical expertise of their personnel, constitute their advantages in pursuing and strengthening their activities in promoting the use of fertilizers.

- Only two of the ten farmer's associations/cooperatives, or individual farmers, contacted are active in the promotion, or education in the use of, mineral fertilizers. This is sufficient evidence of the limited abiltity of farmers' organizations in Rwanda to participate in technology transfer. Most farmers associations were constituted in the post-war era, in order to benefit from the material support of NGOs and other international institutions. There is an enormous need for training to strengthen their skills in terms of management techniques. Farmers associations have a great potential to promote the use of fertilizers among their membership.

- None of the three operators of the private sector is involved in research or extension activities on fertilizers. Yet they feel the need to become involved in this activity. The rate of increase of a businessman's business volume will depend on his knowledge of the use of fertilisers by farmers, who could then increase demand for this commodity. The experience in Kenya of involving the private sector in research and promotion of the use of fertilizers on tea cultivation is a good example of the potential awaiting the private sector in Rwanda. Profits generated by the marketing of fertilizers upstream, and agricultural products downstream should provoke the private sector to cooperate closely with other partners to improve the impact of agricultural research and extension on the use of fertilizers in Rwanda.

3.4. Use of Fertilizers by Type

Recent studies, carried out by the FSRP Project (Kelly and Murekezi, February 2000) and by FAO/IFS (Murekezi, May 2000) on the yield of mineral fertilizer use in Rwanda, have shown that the combination of DAP (18-46-0) et urea (46-0-0) provides better results than the use of a mixture of NPK and urea, in terms of the ratio of the value of additional production created by the use of fertilizers and the cost of these fertilizers (VCR = ratio-cost ratio.)

During this study, we decided to verify if the operators interviewed had already decided to use DAP to optimize the impact of agricultural research and extension. The results of these interviews are presented in table 2, as follows.

- This table shows that the use of the NPK fertilizer type continues to predominate, rather than diammonium phosphate (DAP), even though the use of DAP is common in the field, according to the DRSAs, projects, NGOs and farmers associations.

Table 2: Use of Fertilizers by Type

Type of fertilizer Partner	NPK	DAP	urea	NPK-urea	DAP-urea
ISAR (1)	1	-	1	1	-
OCIR/Coffee (1)	1	-	1	1	-
OCIR/Tea (1)	1	-	-	-	-
DRSA (7)	7	6	6	6	6
Projects (6)	4	5	5	4	5
NGOs (7)	7	6	6	6	6
Associations/ cooperatives and farmers (10)	10	8	8	8	8
Private sector (3)	3	1	1	1	1

N.B.: The number in parentheses indicate the number of persons interviewed

- All public operators approached at the level of government institutions (ISAR, OCIR/Coffee, OCIR/Tea) declare that they use or recommend the use of the NPK fertilizer type. Such fertiliser formulations (NPK 25-5-5, NPK 20-10-10, NPK 20-5-5, with an addition of KCl) are appropriate for tea, according to Anaclet Rutaremara, of OCIR/Tea (communication personnel) and Ryabwite Pierre of SORWATHE (personal communication). It needs to be emphasized that these types of fertilizers are recommended by the Tea Research Institute of Kenya, but the amount applied by OCIR/Tea (400 kg/ha) differs significantly from that of SORWATHE (1,100 kg/ha). Yields vary from 1,300 kg of dry tea/ha for OCIR/Tea to 3,500 kg/ha for SORWATHE, thus showing an important potential for the use of fertilizers in tea cultivation.

- Recommendations for fertilizers used on coffee (NPK 20-10-10 with 200 gr/plant/season and 46-0-0 urea with 150 gr/plant/season) came from the old tests by ISAR, according to Ephrem Niyonsaba (personal communication). It was not possible, however, to find the results of these tests to calculate the profitability of fertilizers on coffee. However, commercial coffee cultivation offers enormous growth possibilities in fertilizer consumption in Rwanda.

- ISAR does not yet use DAP in its trials in spite of the availability of results that show the advantage of combining DAP with urea in contrast to a mixture of NKP/urea. However, ISAR proposes to start trials with DAP/urea during the next growing season in an attempt to make up for lost time.

Most of the public-sector operators use as much of the NPK/urea (6 of 7 DRSAs and 4 of 6 agricultural projects) as of the DAP/urea (6 of 7 DRSAs and 5 of 6 agricultural projects) in their educational-promotion activities.

- Most persons contacted at the NGOs (6 of 7), farmers' associations and individual farmers (8 of 10) use the DAP/urea combination, and even 1 of 3 private-sector operators interviewed affirm that they market all three types of fertilizers (NPK, DAP, urea) depending on availability. This suggests that the progressive transition from NPK to DAP has already begun, but this transition could be strengthened by extension packages including demonstrations, training, messages targeted on the preferable types of fertilizers, etc.

3.5. Perception of Partners on the Constraints in the Use of Fertilizers

To enable the use of fertilizers to enter a phase of quick growth in Rwanda, it is necessary that researchers, extension agents, fertilizer distributors, and farmers overcome certain constraints. The constraints on the use of fertilizers addressed in this section are those that are directly related to fertilizer research and extension. The three main constraints identified by partners interviewed are the lack of support resources for extension, weak technical skills of farmers in fertiliser use, and the lack of operational liaisons between research and farmers. Table 3 below summarizes the interview results with partners in relation to the main constraints perceived.

Table 3: Partners' Perceptions of Constraints on the Use of Fertilizers

Constraint / Partner	Deficient extension mechanisms	Weak technical skills of farmers	Research not linked to needs
Public operators (19)	9	6	5
NGOs (7)	2	3	1
Associations/ cooperatives/farmers (10)	-	3	1
Private sector (3)	1	3	1

N.B.: The numbers in parentheses indicate the number of persons interviewed

The farmers' weak technical skills are the first constraint that limits the impact of extension and research on the use of fertilizers. This outcome confirms the findings of the FSRP Survey (2000A) that 53 % of farmers do not use fertilizers because they do not know them well enough to trust sellers (Kelly, Mpyisi, Shingiro, Nyarwaya, January 2001). There are, however, strong regional variations in Byumba (22 %) and in Kigali Rural (27 %). This implies that promotion of the use of fertilizers should be differenttiated. While much effort is being invested to educate farmers who still do not know enough about fertilizers, it is necessary at the same time to promote the more intensive use of fertilizers to the 12 % of farmers who already use it. For the latter, the priority is to assure regular supply of fertilizers at the local level.

- Public-sector partners strongly emphasise the lack of human and material resources for promotion/dissemination efforts. Human resources are limited. There exist 245 A2 and A3 level agronomists (6 or 4 years respectively of education in secondary school oriented towards agriculture) for all 154 communes in Rwanda, as shown in the table in annex 3. The agricultural monitors (MONAGRI), or basic agricultural trainers, were eliminated in 1998 because of their incompetence but also as a result of budget constraints. The MINAGRI operating budget for the calendar year 2000 was set at the level of 1,540,246,576 Rwandan francs (FRw) of a total government budget of 169,151,758,161 FRw ("Journal Officiel de la République Rwandaise, of 31/12/1999 bis) or less than 1 percent of the state operational budget!

- The elimination of the MONAGRI should have been progressive as other qualified personnel were recruited and farmers' skills strengthened to assure a continuity of fertiliser extension, as well as of other programs.

- Public sector-operators also point out that research not linked to farmer's needs constitutes a major constraint that limits the impact of extension and research on the use of fertilizers, but it seems that the NGOs and farmers associations have relatively little concern with this restraint. This is probably because planning and research evaluation were traditionally carried out without consulting other partners in the field, but the situation is improving with the new strategic approach to agricultural research. In this sense, the new PEARL Project: Partnership for Enhancing Agricultural Research and Linkages (USAID/MSU) could be very useful to promote operational liaisons among the different parties involved with fertilizers.

3.6. Methods to Promote the Use of Fertilizers

The impact of extension on the use of fertilizers will depend not only on the way promotion of the use of this agricultural input is implemented, but also on the method used. The choice among various alternative promotion methods for the use of fertilizers will be dictated by a comparison of costs and advantages associated to each method.

Promotion methods for the use of fertilizers most often mentioned by the persons interviewed include demonstration plots, training, study trips, publications, and radio/television announcements. Results of these interviews are shown in table 4 below.

- Besides farmers associations, all other public and private operators, as well as NGOs, prioritised demonstration plots above all other extension methods. They believe that demonstration plots are the most effective way to promote the use of fertilizers. The undeniable advantage of this method is the visual effect observed by the surrounding farming community, but also for traders, concerned to see farmer's demand for fertilizers grow, so that may distribute more fertilizer.

Table 4: Preferred Methods for Promoting the Use of Fertilizers

Method / Partner	Demon-strations	Training	Study trips	Radio & TV announce-ments	Publications (newspapers & brochures)
Public-sector operators (19)	14	11	5	4	6
NGOs (7)	6	6	5	2	1
Farmers' associations/ cooperatives (10)	2	4	2	-	-
Private sector (3)	2	1	-	-	-

N.B.: The numbers in parentheses indicated the number of persons interviewed

- The impact of extension for the use of fertilizers will become even more important when the results of demonstrations become conclusive and very visible. This will require these demonstrations to be widely distributed in terms of spatial distribution and crops chosen. The 480 demonstration plots being installed by the 3 partners (DVC/FSRP/GRCS) for season 2001B constitute a good beginning in the promotion of the use of a combination of DAP and urea fertilizers, but the number of plots should be doubled during the next growing season (2002A) to have one demonstration per "cellule" (fourth-level administrative area) that could maximize the impact on the use of fertilizers.

- These demonstration plots will be installed in places frequently visited by all interested parties, and results will be presented to the public by extension agents, who are sufficiently qualified to explain clearly the profitability of fertilizers. Demonstrations on fertilizers could become a priority task for the DRSA extension agents and agricultural projects. Resources of non-governmental organizations can also be mobilized to assure monitoring of field operations. MINAGRI's DVC will have the role of general coordination of the extension, as well as that of liaison with ISAR for fertiliser R&D.

- Farmers' associations stress training as an outstanding way to promote fertilizer use. This expression of training needs reinforces another opinion expressed in the same interview and according to which the main constraint in the use of fertilizers is the farmer's lack of technical skills. Thus a strong training program could answer this concern of the farmers.

- Public-sector operators emphasize the use of brochures that present comprehensible information on techniques and fertilizer markets. They also recommend, but with lowest priority, the use of radio and television broadcasts. We must point out that among the farmers' associations visited, none mentioned these last two methods. The organization of these media to promote fertilizers could be re-conceived in order to prepare a better message, to better target the public, and to better choose the distribution channels for brochures and the announcement times for radio. One of the subjects to emphasize currently in the written and spoken press is the types of fertilizers currently available on the market in Rwanda, their appearance (form, color, etc), recommended formulas, and modes of application.

- The NGOs placed demonstrations, training and study trips at almost the same level of effectiveness. This equivalence may be justified by their complementary nature. The demonstration plots could be the best place for training and guided visits on the use of fertilizers. In addition, NGO financial resources and their field knowledge allow them to organize study trips on the use of fertilizers to benefit the farmers.

3.7. Sharing of Information on Fertilizers

The sharing of information among the different parties involved in fertilizer use is a good indicator of coordination among partners. MINAGRI is in charge of general coordination of all parties involved with fertilizers at the national level, as well as for extension and research and fertilizer supply. MINAGRI is represented by the DRSA at the regional levels. ISAR is in charge of coordinating research and the development of research tasks. In fact, these different levels of coordination currently have many difficulties in fulfilling their roles because of the lack of human and financial resources.

With the objective of understanding the level of coordination among the different operators involved in the use of fertilizers, it was considered necessary to obtain information on the intensity of information exchange among the different partners concerned. Data gathered during interviews are presented in table 5 below.

Data from this table resulted in the following conclusions:

- There has been no sharing of information on fertilizers between ISAR on one hand, and OCIR/Coffee and OCIR/Tea on the other over the last few years. This fact is even more unfortunate than the fragmented technical information available for coffee and tea, despite the fact that the potential consumption of fertilizers for these crops is high.

- As OCIR/Tea uses technical data from Kenyan research on fertilizer use, it would be convenient if that organisation were to share this information with ISAR, and if it would finance R&D to assess the applicability of this data in the tea-cultivation areas of Rwanda. The lack of communication between ISAR and OCIR/Coffee does not allow ISAR to follow-up on the field application of previous research results on the use of fertilizers for the coffee crop.

- All partners interviewed share information with MINAGRI on the use of fertilizers. This is essentially technical information (research, extension, training) and commercial information (supply, price). This volume of information exchange among different operators and MINAGRI gives the latter a natural national-coordination role for all initiatives related to the use of fertilizers. MINAGRI could therefore implement a data collection system, including all information from the main partners, analyze these data, and widely disseminate the results of this research, while regularly indicating problems to be solved, so that the impact of extension and research on the use of fertilizers would becomes greater.

Table 5: Sharing of Information on Fertilizers

Level of information exchange Partner	MINAGRI Central	ISAR	UNR/ FCAGRO	DRSA
OCIR/Coffee (1)	1	-	-	1
OCIR/Tea (1)	-	1	-	
Projects (6)	6	2	1	4
NGOs (7)	5	2	-	4
Farmers' associations, cooperatives and farmers (10)	2	-	-	8
ISAR (1)	1	na	1	
UNR/AGRO (1)	-	1	na	-
DRSA (7)	7	1	-	na
Private sector (3)	3	-	-	2

N.B.: The numbers in parentheses indicate the number of persons interviewed.
na: not applicable

- Also, most of the partners in the field, except OCIR/Tea, exchange information on fertilizers with the DRSA. Having this field presence is an extra advantage in playing the coordinating role for all fertiliser operations at the regional level. Contacts must be made quickly with the tea industry, however, especially because privatization of the sector will be launched soon, this multiplying the necessity to promote fertilizers among tea farmers.

- The training aspect seems to be practically unlinked to other fertilizer sector operators. Consequently, the Agriculture Faculty of the national universisty (*Université Nationale du Rwanda*, UNR) only exchanges information on fertilizers with three of the 39 partners interviewed. These partners are ISAR, OCIR/Tea and the FSRP Project. Presently, there is no research program on fertilizers at UNR, while such a program could readily contain work on soil fertilization in the form of theses for graduating students.

3.8. Recommendations

In the hope of optimizing the impact of agricultural extension and research on the use of fertilizers, partners should act upon the following policies:

- making agricultural research more effective.
- making the national system of agricultural production profitable.
- improving the capacity of the national extension system.
- creating a link between agricultural research and extension.
- assuring program follow-up and assessment.

ISAR should orient its own research towards the real need of farmers in order to make agricultural research related to fertilizer use more effective. This institute, however, needs to be supplied with the appropriate human and material resources to allow it to better carry out its mission. It is also necessary that all agricultural projects and NGOs become involved in fertiliser R&D.

To make the national agricultural extension system more effective, it is necessary for all partners to join efforts to substitute, progressively, the NPK fertilizer type by DAP (diammonium phosphate). The use of demonstration plots on fertilizers should be part of this transition.

The capability of the national system for agricultural extension should be improved through the establishment of farmers' associations, active NGO participation, and allocation of technical personnel, as well as the necessary means for operations in the field, and use of the media.

The close link between agricultural research and extension should be implemented by a better distribution among the different partners of the tasks of research, extension and R&D, the strengthening of coordination skills by MINAGRI at the national and regional levels, and the development of an active partnership among the different parties involved.

Finally, the impact of agricultural extension and research on the use of fertilizers should be improved through program follow-up and assessment through the gathering, summarizing, and disseminating information on fertilizers, multi-annual programming, and seasonal evaluation of the use of fertilizers.

The different recommendations are presented as a summary on table 6 below.

Table 6: Recommendations

POLICIES	RECOMMENDATIONS
Make agricultural research on fertilizer more effective	• Orientation of ISAR fertilizer trials toward the real needs of farmers. • Allocation of human and material resources to ISAR to fulfill its research mission. • Involvement of all agricultural projects and NGOs in the development of research on fertilizers.
Make the national agricultural extension system more effective	• Substitution of the use of NPK fertilizers with DAP fertilizers. • Endorsement of demonstration plots as an extension method for the use of fertilizers. • Development of an action plan to progressively replace free distribution of agricultural inputs for demonstrations by full payment.
Improving the capabilities of the national extension system	• Education of farmers' associations in fertilization (application techniques, appropriate crops, supply, stock management, profitability) • Allocation of two A2/A3 agronomists to each commune with the main task of counseling farmers on the use of agricultural products in general, and fertilizers in particular. • Supply of enough material for the effective operation of field personnel (means of transportation and demonstration equipment). • Active NGO participation in the promotion of fertilizer use.

POLICIES	RECOMMENDATIONS
Implement a close link between agricultural research and extension	• Clear distribution of tasks related to fertilizers among different partners: • MINAGRI (general coordination of agricultural research and extension) • ISAR (agricultural research and research development supervision) • Parties in the field (R&D, extension of farmer training) • Learning institutions (advanced education) • Private sector (fertilizer import and distribution.) • Development of an active partnership among planners in central government, pertinent parastatal organisations, researchers, instructors, NGOs, extension agents (DRSAs – projects – communes) farmers' associations and the private sector, at the national, regional, and local levels. • Strengthening of MINAGRI coordination skills
Assure follow-up and assessment of the program on the use of fertilizers	• Installation of a system at MINAGRI to gather and disseminate information on the use of fertilizers. • Multi-year programming of research and extension on fertilizers (trials and demonstrations) • Seasonal Evaluation of achievements in the use of fertilizers

Annexes

Annex 1: Identification of the 39 Partners Interviewed

- 2 central administration partners:
  - "Direction de la Vulgarisation et de la Commercialisation" (Promotion and Marketing) at MINAGRI.
  - "Direction de l'Agriculture" (Agriculture) at MINAGRI.
- 3 parastatal institutions:
  - "Institut des Sciences Agronomiques du Rwanda (ISAR)." (Agricultural Sciences.)
  - "Office des Cultures Industrielles du Rwanda" (OCIR/Coffee)
  - "Office des Cultures Industrielles du Rwanda" (OCIR/Tea.)
- 7 DRSAs: Kigali rurale, Gitarama, Butare, Gikongoro, Gisenyi, Ruhengeri, Umutara.
- 1 Commune-level agronomist: Murambi Commune.
- 6 agricultural projects:
  - FSRP Project
  - "Projet de Développement des Marchés Agricoles et Ruraux (PDMAR.)" (Development Project for Agricultural and Rural Markets.)
  - Butare Sud-Est Project (PBSE.)
  - Butare Rice Project (PRB.)
  - Gikongoro Agricultural Development Project (PDAG.)
  - Buberuka Area Rural Management Project (PGERB.)
- 5 national NGOs:
  - "Association Rwandaise pour le Développement Intégré (ARDI)."
  - "Association pour le Développement Rural Intégré (DUHAMIC ADRI)."
  - "Centre de Services aux Coopératives (CSC)."
  - "Eglise Episcopale au Rwanda à Ndiza (EER/Ndiza)."
  - IWACU Center.
- 2 international NGOs: Catholic Relief Service (CRS) and World Vision.
- 7 farmers' associations and cooperatives:
  - IRABEM/Gitarama.
  - UNICOPAGI/Gikongoro.
  - Abagwizamusaruro/Gikongoro.
  - COODAF/Ruhengeri
  - Abiyunze/Ruhengeri.
  - IAKI/Byumba.
  - CODERVAM / Umutara.
- 3 individual farmers:
  - Gashabuka Paul/Gisenyi.
  - Bizimana JC/Byumba.
  - Singirunkunda Aloys/Umutara.
- 3 private-sector partners:
  - Ngarambe Jonas/Gisenyi.
  - SORWATHE.
  - Murenzi Supply Company.

Annex 2: Geographical Distribution of Partners Interviewed

Prefecture Partner	Kigali ville	Kigali rural	Gitarama	Butare	Gikongoro	Gisenyi	Ruhengeri	Byumba	Umutara
Central govern-ment (2)	2								
Parastatal organisations (3)	2			1					
DRSAs (7)		1	1	1	1	1	1		1
Commune agronomist (1)									1
Projects (6)	2			2	1		1		
National NGOs (5)	3		2						
International NGOs (2)	1							1	
Farmers' associations & cooperatives (7)			1		2		2	1	1
Individual farmers (3)								1	1
Private sector (3)	2						1		

N.B.: The numbers in parentheses indicate the number of persons interviewed by each category of partner.

Annex 3: Minagri Agronomists (October 2000)

Rank	**Agronomists**			
Location	**A0**	**A1**	**A2**	**A3**
Central administration	28	6	14	0
DRSA KIGALI	1	0	22	4
DRSA GITARAMA	0	1	21	7
DRSA BUTARE	4	1	25	2
DRSA GIKONGORO	4	1	24	2
DRSA CYANGUGU	2	2	9	8
DRSA KIBUYE	1	0	7	2
DRSA GISENYI	3	1	13	2
DRSA RUHENGERI	5	3	19	14
DRSA BYUMBA	4	4	14	5
DRSA KIBUNGO	4	2	10	7
DRSA UMUTARA	2	2	12	2
Total Regional Departments	**30**	**17**	**176**	**55**
TOTAL	**58**	**23**	**190**	**55**
	326			

Source: MINAGRI/Service Administratif, cited by Jacques Faye, November 2000.

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4. Fertiliser Marketing and Distribution in Rwanda

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From 1995 – 1999, fertiliser mostly meant 17:17:17 to the Rwandan farmer, if it meant anything at all: many of Rwanda's farmers have never seen fertiliser. During this period, to the extent that the farmer could buy any fertiliser it was almost always of this type because the EC supplied and subsidised it. They recognise its familiar granular structure and colour. They are often wary of different fertilisers that they do not know as well, such as DAP and urea. Farmers growing tea and coffee also had access to other types better adapted to the needs of these crops though, in practice, they often applied it to other crops or sold it locally.

17:17:17 is most widely available. DAP and urea are also available in many places. In addition, Ruhengeri traders offer MAP for sale. Fertiliser quality is generally good but some problems of misrepresentation and poor quality have been raised. COODAF, a co-operative in Ruhengeri, procured fertiliser in the July – September 2000 period. It bought from a formal-sector Kigali source and from an informal-sector Ruhengeri source. The Ruhengeri batch did not dissolve well. Formal-sector operators who receive fertiliser from a well-defined and accountable market chain, with a reputation to uphold, have few worries about quality, standards or labelling.

4.1. Liberalisation

Over the course of the 1995-99 period, subsidised EC 17:17:17 dominated the Rwandan fertiliser sector. In addition, OCIR/Thé and OCIR/Café procured fertilisers specific to their crops, such as 25:5:5, 20:10:10, 20:5:5 and potassium chloride. By the end of this period, subsidies – that had been at 50 percent – fell to zero, and the government had decided to leave the marketing of agricultural inputs to the private sector, meaning traders, co-operatives and producers' associations. In January 2000, a MINAGRI initiative, the Agricultural and Rural Market Development Project started working to promote improved agricultural marketing, including that of fertilisers. This paper considers the Rwandan market for fertilisers in this post-liberalisation period.

4.2. Market Chain

Table 1 breaks down how farmers obtained fertiliser by means and source in 1998-99, a period when liberalisation had not yet taken place. It shows that:

- cash purchases from traders accounted for over half the fertiliser bought
- associations and co-operatives provided just under a quarter

[20] Thanks are extended to Alain Houyoux (PASAR) and the PASAR/MIS market monitors; DRSAs in Ruhengeri and Gikongoro; fertiliser traders in Gikongoro, Kibuye and Ruhengeri Prefectures and in Kigali City; co-operatives and farmers' associations in Umutara, Kibuye, Kigali-Rurale, Gikongoro and Ruhengeri; World Vision agents in Kigali City and Byumba Prefecture; MINICOM staff; and MSU/FSRP staff

- traders granted credit in less than two percent of their sales to farmers whereas associations and co-operatives granted credit in almost 40 percent of cases
- in 1998-99, DRSAs were still distributing fertiliser but by 2000 this source would have largely dried up.

Table 1: Fertiliser Purchased by Type of Financing and Supplier (1998-99) (percentage for entire country)

	NGO	Association or Co-op	Trader	DRSA	Other farmer	Total
Gifts/aid	6	1		1		8
Credit		9	1			10
Cash		13	56	8	5	82
Total	**6**	**23**	**57**	**9**	**5**	**100**

Source: Republic of Rwanda, Ministry of Agriculture, Animal Resources and Forestry, Food Security Research Project and Division of Agricultural Statistics 2001. *Agricultural intensification in Rwanda: an elusive goal – fertiliser use and conservation investments* prepared by V. Kelly et al., Kigali: January, p5

Figure 1 shows schematically estimated commercial fertiliser flows for 2000. It starts with formal-sector imports of 6,500 tonnes and informal sector imports of 2,000 tonnes. 5,400 of the formal-sector imports flows to tea and coffee farmers, via OCIR-Thé and OCIR-Café. We assume that the farmer reallocates 10 percent of this to other crops and another 10 percent to the black market, even though fertiliser for these crops is not optimally balanced for others.[21] NGOs (216 tonnes), associations & co-operatives (829 tonnes), and traders (2,055 tonnes) buy the remaining 1,100 tonnes of formal-sector imports, along with all 2,000 of the informal-sector imports, i.e. 3,100 tonnes. The weightings for three conduits are derived from the 1998-99 data in table 1, assuming that:

- the "DRSA" portion is no longer valid in 2000
- the "Other farmer" portion is just a reallocation *within* the farming community

[21] The fertiliser procurement details of OCIR-Thé and OCIR-Café appear in a sister paper on imports. In theory, the fertiliser that these two parastatal organisations procure goes straight to the plantation or out-grower (in the case of tea) or the coffee farmer (in the case of coffee) and is applied directly to the intended crop. In practice, some of the fertiliser allocated to these ends finds its way to other crops or, via a black market, to other farmers. In the past, even a military presence to enforce the application of fertiliser to tea only partially curbed the re-allocation of fertiliser elsewhere. One factor limiting the re-allocation of OCIR fertiliser has been that much of it is not optimal for use on other crops. In the case of tea, for instance, parastatal purchases in 2000 included 25:5:5, 20:10:10, 20:5:5 and KCl. The suboptimality of these fertilisers for application to other crops limits the leakage from beverage crops, and thus limits their generalised substitutability on the black market. The re-allocation takes place on a local scale that many observers have detected but none has quantified. Separating the proportion of these fertilisers that does not reach its intended crop into that which the farmer applies to other crops and that which he sells locally has, so far, defied estimation. We provisionally use a guestimate of 10 percent for the quantity marketed. In 2000, this would amount to 540 tonnes of fertiliser throughout Rwanda (or approximately two lorryloads per prefecture, on average).

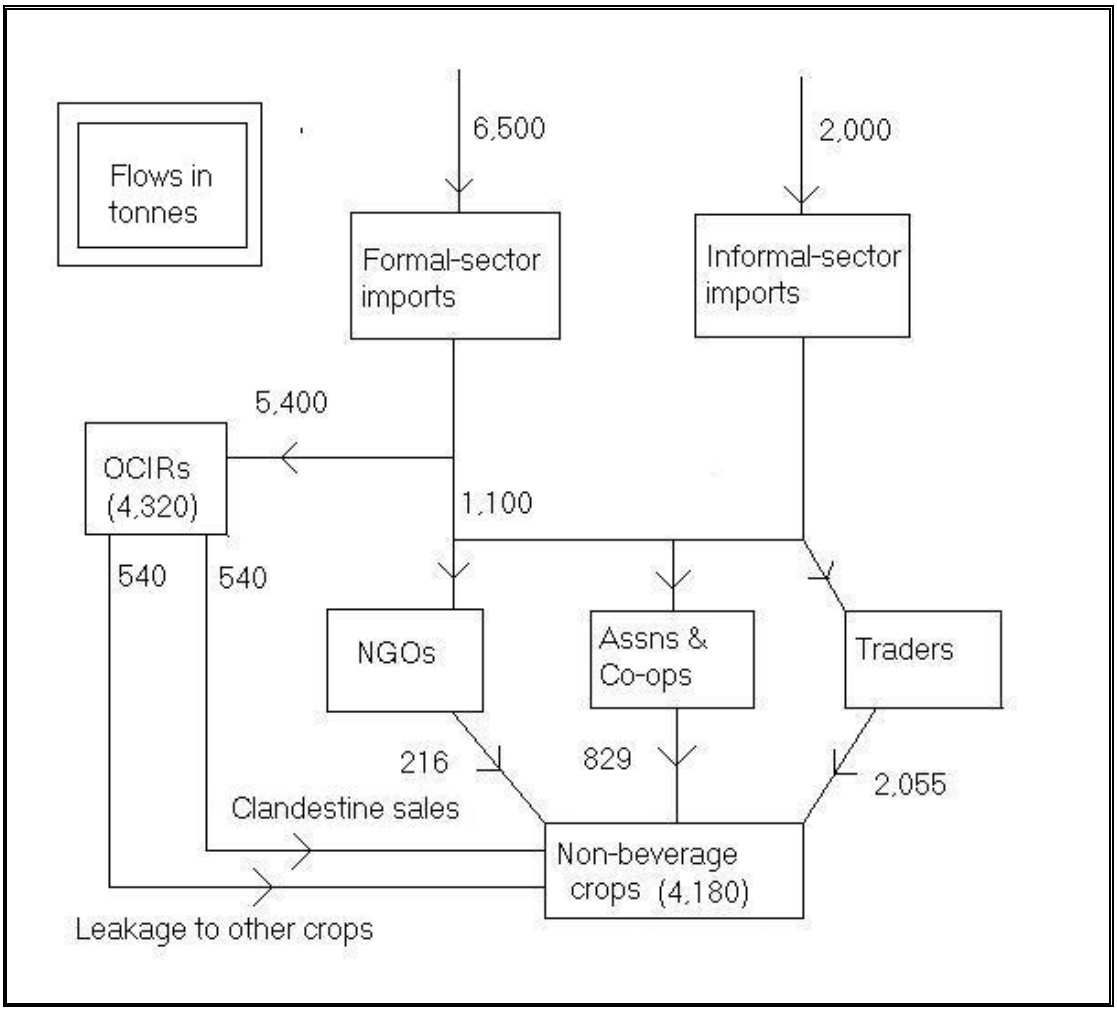
so these portions are split between the other conduits as a function of their importance.[22]

Using these assumptions, we deduce that 4,320 tonnes are used on coffee and, mostly, tea; and that non-beverage crops receive 4,180 tonnes. This represents a roughly even split between the two sectors.

NGOs are sometimes accused of subsidising fertiliser and thus distorting market incentives. To the extent that this is true, they appear to have a relatively small share (2.5 percent) of the market.

The numbers that appear in figure 1 are estimated national totals. The relative importance of the different market flows may vary considerably in different parts of the country.

Figure 1: Estimated Rwandan commercial fertiliser flows, 2000



[22] Note that the diagram could be redrawn to show some portion of "clandestine sales" feeding into the "Traders" box.

Survey results from MINAGRI's Food-Security Research Project suggest that the average quantity that Rwandan farmers bought in 1998-99 equalled 3,500 tonnes, a number broadly consistent with BNR figures for the mean quantity imported in 1998-99. Data on imports in 2000 suggest that Rwandan farmers use a figure of 3,100 tonnes for crops other than tea and coffee, assuming informal imports of 2,000 tonnes. It seems that fertiliser imports for 2000 are significantly higher than for 1998-99, so informal imports may be significantly higher than the estimate above of 2,000 tonnes.

Distribution to the farmer level mostly takes place through private-sector operators. Co-operatives and wholesale traders by fertiliser from importer and sell by the sack; retail traders and producers' associations sell in units of less than a sack. In addition, as part of their projects, NGOs may distribute fertiliser, sometimes subsidised.

Co-operatives generally unite a series of farmers' associations, providing them with a common input marketing structure and granting them credit. Some co-operatives are unwilling to take on new member associations because of problems in recovering debt from existing ones. Co-operatives also usually sell fertiliser to non-members if they can pay cash.

Wholesalers may be well-established agricultural-input companies, such as Africhem or Agrochem, or companies that sell no agricultural inputs other than fertiliser. They may be formal-sector companies, such as Murenzi Supply or Agrochem (in Kigali), or informal-sector companies such as Virunga (in Ruhengeri). Wholesalers may grant credit to retailers or to those who buy by the sack. The allocation of credit is generally established on a pragmatic, case-by-case basis.

Most of this diversity is repeated at the retail level. Retail sales may take place in a modern shop (e.g. Agrotech), in a provincial agricultural-supplies retailer, or loose either in the weekly market or from a villager's house. Retailers break the 50 kilogramme sacks and sell fertiliser loose by the bag. The Food-Security Research Project documented sales of as little as 250 grammes and 97 percent of farmers bought less than a sack per season.

Data collected by MINAGRI's Food Security Research Project from a sample of approximately 1,500 households show that only 72 bought fertiliser. Together they bought 1.59 tonnes or a mean of 22 kilogrammes per household. However, this mean hides a highly skewed distribution: the median equals 10 kilogrammes and the mode 1 kilogramme.

4.3. Distribution by prefecture[23]

Table 2 provides a ranking of prefectures by their reputation for fertiliser use and purchases. The table is not based on measures of quantities used but rather on a consensus among informed observers.[24]

[23] Details by prefecture of fertiliser availability come from a variety of sources but include nationwide details from the market monitors working from the EC-financed *PASAR*.

[24] Data from the same source that generated table 1 provide a breakdown by prefecture but these results suggest that Gisenyi used 40 times more fertiliser per person than Ruhengeri, which is difficult to reconcile with impressions provided by other observers. Therefore these data are not reproduced here.

Prefectures vary considerably not only in the relative importance of fertiliser in agricultural production but also in the relative importance in distribution of co-operatives and associations, on the one hand, and traders, on the other.

Table 2: Inferred Ranking of Prefectures by Fertiliser Use

Rank	Prefecture
1	Ruhengeri
2	Gisenyi
3	Gikongoro
4	Byumba
5	Gitarama
6	Cyangugu
7	Kigali-Rurale
	Butare
9	Kibungo*
	Umutara
11	Kibuye

*: Kibungo's low ranking obscures the fact that the area around Rwamagana uses a lot of fertiliser.

In Ruhengeri, the fertiliser trade is well developed, with a choice of wholesalers and a diversity of retail traders providing up to five types of fertiliser in Ruhengeri Town. In addition, throughout the prefecture, local traders who have bought one or more sacks in Ruhengeri Town retail these by the kilogramme in their villages. However, retail coverage is far from complete. Even in parts of northern Ruhengeri, where returns to fertiliser are high, many farmers do not have dependable local access to fertiliser within an easy day's walk.

Both wholesalers and retailers may grant sales on credit. The extent to which it is granted depends on local competition for market share and the reputation and credit history of the individual seeking credit.

A series of producer associations in Ruhengeri Prefecture complements this trading system by providing fertiliser, and other inputs, to its members, often on credit. The prime example of this is COODAF, a co-operative that supports producers' associations that specialise in growing seed potato. COODAF provides inputs to its member associations, on credit if necessary.

Many Ruhengeri farmers know the value of an appropriate fertiliser to their bottom line, can often distinguish different fertilisers and their suitability for a given crop, they sometimes mix them to provide an optimal nutrient mix and, crucially, can obtain them locally throughout the prefecture. So, it is not surprising that Ruhengeri accounts for the greatest use of fertiliser in Rwanda. However, even there, a combination of purchasing power and availability provides a severe limit to farmers' access to this crucial input.

Gisenyi, adjacent to Rwanda in northwest Rwanda, takes the number two ranking in fertiliser use. What can be said for Ruhengeri is also largely true for Gisenyi. However, Ruhengeri Town is the major fertiliser trading town the northwest so much of the wholesale trade for Gisenyi actually takes in Ruhengeri. The adjacent Prefectures of Gisenyi and Ruhengeri may be grouped together, and apart

from other prefectures, for two reasons. In production, they share rich volcanic soils on their northern flanks; in a marketing sense, a good tarred road links them together.

Although Byumba Prefecture also lies in northern Rwanda, it lacks volcanic soils and a good road link to the northwest. In Byumba, associations in each commune pool their orders via a co-operative that purchases on their behalf. In addition, two traders also sell fertiliser on a small scale.

At least until recently, in the south/central part of Rwanda containing Gitarama and northern Butare Prefectures, as well as the Bugasera portion of southern Kigali-Rurale Prefecture, many active producers' associations procured fertiliser for their members directly from the importers in Kigali. They did not channel their buying power through one or more big co-operative buying clubs. However, after the recent drought there, is some doubt about how active the Bugasera co-operatives are now. Though associations have dominated the supply of fertiliser to this part of the country, some traders also sell it. These include a possibly unique chain of four stores – Sainte Rita – that sells agricultural inputs in Kigali City and Gitarama Town, as well as further south in the towns of Butare and Gikongoro.[25] Other parts of Kigali-Rurale are worse-served by local associations but farmers are often close enough to Kigali City to buy from suppliers there.

In the south of the country, Gikongoro stands out as the largest user of fertiliser. It has a co-operative located in Gikongoro Town that supplies the commodity to producers' associations in each commune. In addition, the town has a branch of the Ste Rita chain and a private wholesaler in Mudasomwa, supplied from Burundi. In adjacent Cyangugu, traders dominate the supply mechanism and there is evidence that these traders also have Burundian suppliers, though not necessarily exclusively.

In Kibuye, one or more associations provide fertiliser to their members but very little appears in the market. PASAR frequently reports "not available" for different types of fertiliser in this prefecture. In the eastern prefectures of Umutara and Kibungo, farmers also have relatively poor access to fertilisers. In these prefectures, traders account for a higher proportion of supply than producers' associations.

4.4. Market Regulation

The fertiliser market is unregulated. The Ministry of Commerce, Industry and Tourism is currently establishing a bureau of trading standards which may be able to test fertiliser quality. At the moment, unsatisfied buyers can send samples of fertiliser to a testing laboratory at the *Université National de Rwanda*. However, such testing costs 60,000 RwF, a sum that retailers and some wholesalers find daunting. The Ministry of Commerce, Industry and Tourism (MINICOM) is currently setting up a trading standards office. It remains to be seen to what extent this office will be able to provide a swift and cheap solution to disputes on fertiliser quality.

4.5. Market Conduct

An underlying assumption justifying liberalisation of Rwanda's fertiliser marketing system is that a free market in fertiliser will lead to more efficient trade. It is assumed that a competitive market will

[25] The diversity of supply sources in this part of the country leads to a high spatial variation in retail prices.

emerge that will allow spatial and temporal integration through arbitrage and that consumers will have real choice between different products and different sources of supply. Proponents also assume that the "invisible hand" of the market will ensure that the fertiliser supply offered by a competitive market will be sustainable, in contrast to the unpredictable ebb and flow that has resulted from projects that come and go, as well as from administrative fiat. This would provide a dependable supply that will give farmers the confidence to invest in an input that analysts (and many farmers) know will increase their incomes

Rwanda's two major sources of supply arrive

- from the world market in Kigali
- from Nairobi in Ruhengeri.

In Kigali, one importer, Murenzi Supply bought 800 tonnes of fertiliser in 2000, in addition to fertiliser he procured for OCIR-Thé after having won a tender to supply them. The director of this company is keen to train his staff, develop links to his client base through involvement in agricultural extension[26], and is considering opening branch offices outside Kigali.

This wholesaler provided fertiliser to two other wholesalers who did not import last year. One of these two (CEGI) imported fertiliser in early 2001 and the other (Africhem) has stated an intention to import in May 2001. Nonetheless, competition between Kigali wholesalers appears less than complete when they sell to each other. Agrotech and Agrochem, two other Kigali wholesalers who stock a range of agricultural inputs, appear not to be importing significant amounts of fertiliser in the post-liberalisation period.

In contrast, since liberalisation, three informal-sector wholesalers with warehouses serving as offices have opened businesses in Ruhengeri. They appear to be aggressively taking market share in the northwest of Rwanda.

These two sources of supply meet and compete principally in Ruhengeri Town. The COODAF co-operative, wholesalers, retailers and consumers can choose between products imported from the north (mostly from Nairobi), and those imported from the south (from Kigali). Individual wholesalers generally have stock from one provenance or the other but it is possible to see 17:17:17 from both provenances on sale in some stores. This suggests real competition between at least two sources of supply in the northwest.

It seems doubtful that as much competition takes place in other parts of the country. Fertiliser still scarcely appears on the market in much of Kibuye, Umutara and Kibungo Prefectures; and in other areas outside the northwest the choice of supply seems to be limited to that from the Kigali wholesalers. Information linkages between these different regions seem weak: dealers in one part of the country often do not know price information from others. This suggests a segmented – and thus inefficient – market.

Projects often still try to provide subsidised fertiliser to farmers, thus undermining the market, albeit with good intentions. However, as mentioned above, their throughput appears to be limited.

[26] A Gikongoro trader already has a roadside plot that readily shows to those in the area the response of potatoes and maize to fertiliser.

It seems that supply from the north has a tainted reputation. This supply comes mostly from several big Nairobi-based importers, rather than directly from the world market. The indirect supply chain means that the Ruhengeri-based importers from this source do not have complete control over product quality. At least one shipment of 17:17:17 appears to have contained granules of fertiliser that dissolve slowly enough to noticeably compromise plant growth. This shortcoming has generated negative publicity for the Ruhengeri-based importer responsible.

In addition to the much-discussed shipment with putative low solubility, sources suggested other problems of quality with supply from northern sources: the repacking of unknown fertilisers in sacks carrying labels well-known and respected in Rwanda, crude remixing of fertilisers, and dilution of nutrient content. However, no one suggested that this occurred within Rwanda. Rather such shady dealing was attributed to economic operators in Uganda and Kenya. Nor did informants suggest that, in the alleged low-solubility case, the Ruhengeri-based trader was to blame. Indeed this seems unlikely: this trader seems to have a profitable trading base in Ruhengeri that it would be short-sighted to compromise via a sullied trading reputation.

Kigali-based suppliers have the advantage that they buy directly from reputed world-market suppliers and, so far, have suffered no instances of poor-quality shipments. According to a Ruhengeri wholesaler who was selling 17:17:17 from both sources at the same price, customers prefer the product from Kigali. As one might expect, Kigali-based importers play heavily on the untainted reputation that their products enjoy.

Interviews suggested no problems with sack weights or measures used at retail level.

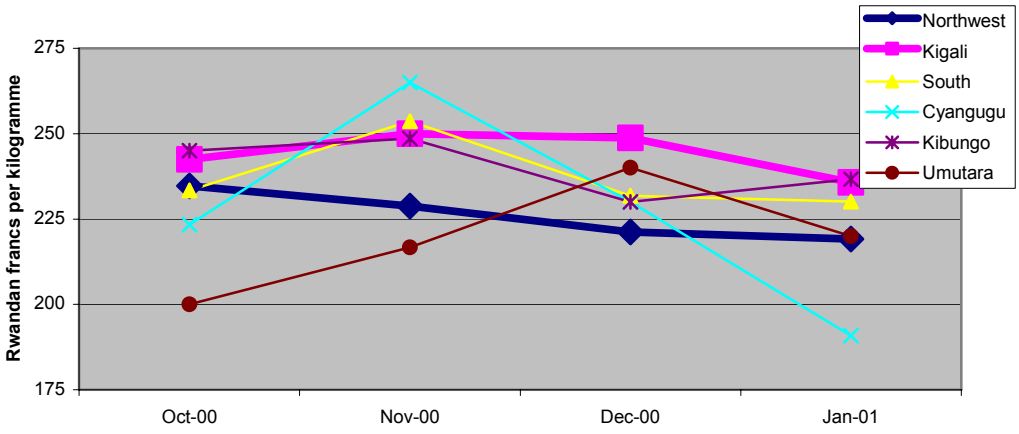
4.6. Market Performance

After the crucial month of May 2000, when the import tax and ICHA on fertiliser was removed, prices did not fall correspondingly. This is understandable because existing stocks were large.

Since October 2000, the EC *Projet Appui à la Sécurité Alimentaire* (PASAR) has collected fortnightly retail prices for three types of fertilisers – NPK, DAP and urea – in several markets in each prefecture, from which it calculates prefectural averages. To date, no information about prices or availability from this source of data has been broadcast or otherwise fed back to Rwanda's private sector or consumers.

Several inferences emerge from analysis of the PASAR data from October 2000 to January 2001. Firstly, the absence of prefectural averages indicates where different types of fertiliser are available for sale. Retail sale generally means sale in kilogramme bags. In almost all cases, NPK was available in at least one market in each prefecture in the four months in question. The exception was Kibuye where, in October, traders were not selling NPK – or indeed any other fertiliser – in any of the three markets surveyed. Urea enjoyed a similar level of retail availability over this period, except in Umutara where it was only found for sale in December. In contrast, at least one retailer offered DAP for sale during all four months in only Kigali City, Gisenyi and Ruhengeri. At least one stocked DAP in three out of four months in Butare and Byumba; for two in Cyangugu, Gitarama, Kibungo and Umutara; and for only one in Gikongoro, Kibuye and Kigali-Rurale.

Graph 1: Retail NPK price (monthly means)



Source: PASAR
Note: "Northwest" includes Byumba, Ruhengeri, Gisenyi and Kibuye; "Kigali" includes Kigali City and Kigali-Rurale; "South" includes Gitarama, Butare and Gikongoro.

This description of availability provides a flattering image of fertiliser availability because only one trader need have offered a few one-kilogramme bags for sale on one occasion in a given month in one market in order for fertiliser to be "available".

Over the limited period for which PASAR has collected these data, we may distinguish the geographic pattern of prices in October 2000 from that which persisted over the next three months. In October – when there was a generalised shortage of fertiliser in Rwanda's segmented markets – there was no clear price gradient for fertiliser across the country. For NPK, the lowest price (200 RwF/kg) obtained in Umutara and the highest (245 – 250 RwF/kg) in nearby Kibungo and Kigali City. Throughout the rest of the country the evidence suggests that the price lay between these extremes, where retailers had stocks. For DAP, PASAR found the highest prices (250 RwF/kg) in Kibungo and Cyangugu, with the lowest prices (187 – 190 RwF/kg) in intermediate prefectures, Gikongoro and Gitarama. For urea, the highest prices (250 RwF/kg) appeared in Kigali City, Kigali-Rurale and Kibungo, while the lowest prices (220 – 225 RwF/kg) were to be found in the northwest (Gisenyi and Ruhengeri) and south (Cyangugu, Gikongoro and Butare).

In the second period – November 2000 to January 2001 – a different pattern emerges. The northwest provinces of Gisenyi and Ruhengeri provide the cheapest fertilisers of all types throughout the period. In some months, other provinces have about the same – or occasionally lower – prices, but the northwest is always amongst the least-cost sources. For NPK, retail prices in the northwest range from 215 – 225 RwF/kg. In addition, Kibuye consistently matches these prices, as do Umutara, Cyangugu and Gikongoro in one month each. Prices for DAP in Gisenyi and Ruhengeri (200 – 210 RwF/kg). As mentioned above DAP is scarcer elsewhere but it is available at similar prices for one month of the three in Kigali City, Kibuye, Umutara and Byumba. For urea, prices in the northwest range from 200 – 223 RwF/kg. Byumba and, particularly, Cyangugu also have low prices in December and January, while Kibuye may be added to this list in December only.

Unfortunately, PASAR only began to collect nationwide fertiliser prices in October 2000. Existing data allow a limited picture of trends in fertiliser marketing. This valuable work should be continued and the data analysed to infer:

- seasonal price trends
- secular changes in price levels
- inter-prefectural commodity flows
- the levels of integration of markets for:
  - each type of fertiliser between different market pairs
  - different types of fertiliser within given markets.

Combined with information on prices in source markets, transport costs and transaction costs (warehousing, wage bill, cost of capital, losses, etc.) these data allow the analyst to infer the profitability of the fertiliser trade. Together, measures of profitability and market integration would provide a good measure of the health of the fertiliser-marketing business.

Graph 1 shows the price trends for the four months of available retail price data for NPK, in homogeneous regional groupings (chosen by visual inspection of data by prefecture). It illustrates the lines for the northwest and Kigali in bold because these areas are important ones for fertiliser marketing. Note that the price in the northwest remains consistently lower than that in Kigali by between 8 and 28 RwF/kg over this period. Prices in Kibungo and the south of the country do not deviate significantly from the envelope defined by the profiles for these two major trading areas. In contrast, Cyangugu and Umutara show trends that differ significantly from those in other parts of the country, and from each other. The Cyangugu profile could represent a Burundian influence, whereas that for Umutara may reflect residual stocks of unsold fertiliser from the days of subsidies.

4.7. Conclusions

Fertiliser marketing is growing but Rwanda does not yet have a national fertiliser market. Markets are segmented, except in the northwest and – to a lesser extent – in Kigali, in the sense that traders appear not to benefit from profitable arbitrage opportunities. Transport, though in some cases crude, is not a binding constraint to market integration. A lack of information imposes more important limitations.

In the south and, particularly, the northwest of Rwanda, alternative market chains link the country to foreign sources of supply. Thus market entry seems relatively unconstrained and market contestability appears strong. In the northwest, no evidence of monopoly or oligopoly exists at the wholesale level, though many areas do not provide easy retail access to fertiliser for farmers. In Kigali, Rwanda's major wholesaling centre, the appearance of diversity may not mean real competition: two wholesalers buy from a third while a fourth and fifth hold very low stocks. During the first half of 2001, two Kigali wholesalers seem to be importing and this may change the level of competition in the city. In other areas of the country, wholesalers are few and far between and local monopoly seems likely.

Market entry does not present a problem at either the wholesale or retail level in any part of the country: there is enough trading capital that could be reoriented to fertiliser if it were judged

sufficiently profitable. However, in this relatively new liberalised market, segmented and of unknown profitability, traders lack information on the sense of the size and growth of the market. They are still adjusting their expectations of whether to start stocking fertiliser – or how much to increase existing stocks – in uncertain and changing conditions.

Though lack of information is the major source of uncertainty that hinders investment, doubt about fertiliser quality also limits traders' zeal. Without the ability to have access to quick, low-cost testing of fertiliser composition and solubility, wholesalers will rightly hesitate to buy a new source of fertiliser that may be offered at a low price because of suspicions that it may be of inferior quality or that sacks may not contain what their labels suggest.

The Agricultural and Rural Market Development Project is encouraging a range of importers to benefit from bank credit guarantees for fertiliser imports. If these importers, in turn, offer downstream credit to the next step in the marketing chain, then this would create a virtuous circle that would promote growth in fertiliser use. Credit already exists to some degree at the retail level.

MINAGRI and DRSA agents generally have knowledge about fertiliser marketing limited to a partial awareness of what co-operatives and producers' associations do. They are less aware of private-sector trading activity.

Although MINAGRI's PASAR has been collecting fertiliser prices since October 2000 they do not circulate via radio broadcasts or as faxes to interested parties.

4.8. Recommendations

MINAGRI should create a Department of Marketing Services the responsibilities of which should include:

- analysing trends in fertiliser imports by volume and type
- investigating allegations of inferior fertiliser quality
- monitoring trends in fertiliser prices, including the integration of markets
- broadcasting fertiliser prices at wholesale and retail level.

If radio broadcasting of prices could be linked up to popularisation of fertiliser use via MINAGRI's twice-weekly extension broadcasts, which currently come across as stodgy and couched in technical language, so much the better.

MINICOM should ensure that the bureau of standards that it is currently setting up can provide a quick, cheap fertiliser assay that provides details of adulteration or dilution.

Where wholesalers want to become involved in extension, this should be encouraged. ARMDP may want to take a role in this. However, this should not be done in such a way as to subsidise one trader building his client base at the expense of his competitors.

5. Fertiliser Imports and the Import System

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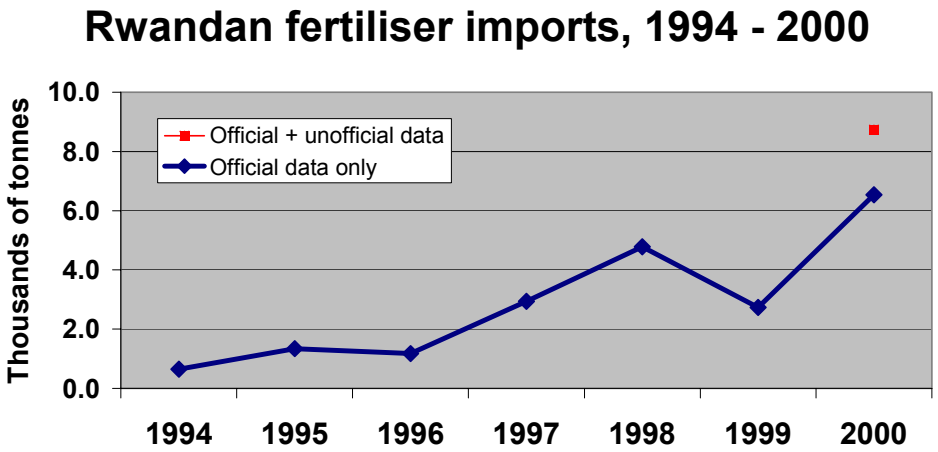
On the small scale on which Rwanda uses fertiliser, in-country manufacturing makes no sense. Rwanda has no comparative advantage in this area, despite the promise of relatively cheap energy from the Lake Kivu gas supply. In the medium-to-long term, Rwanda may develop a demand for fertiliser sufficient to justify a mixing plant that would import fertiliser elements and combine them in different ways to meet the needs of different crop-soil conditions. However, in the short-term, Rwanda is limited to importing fertiliser in standard formulations and at relatively high prices due to its small orders and high transport costs.

Figure 1



Source: République Rwandaise, Banque Nationale du Rwanda, Département des Etudes et Statistiques, *Statistiques économiques et financières* , numéro 20, septembre 2000 & extra BNR data for 10/00 - 12/00

5.1. Fertiliser Import Trends

Fertiliser imports to Rwanda have shown an upward trend in the post-genocide period. However, official statistics show a clear downturn in 1999, corresponding to the drawdown of a large quantity of subsidised fertiliser imported during 1998 and a change in policy during which the government handed responsibility for fertiliser inputs to a relatively unprepared private sector. Since then imports have risen by both official measures and particularly when informal (but legal) imports are added. The official central-bank import figure for 2000 equals 6,537 tonnes. Information from OCIR-Thé suggests that 5,000 tonnes of this correspond to that parastatal's fertiliser imports in 2000. OCIR-Café accounts for a further 400 tonnes. With unofficial exports estimated by the current study at 2,000 tonnes, this figure rises to approximately 8,500 tonnes. It seems that about 3,100 tonnes of fertiliser went to non-beverage crops. See figure 1.

Table 1 provides the breakdown by fertiliser type. It shows that over half Rwanda's fertiliser imputs took the form of NPK 17:17:17 and over a further third were NPK mixes with various proportions of the three elements. Some of these unequal mixes were DAP, sometimes used in combination with urea on many crops; others were mixes made specifically for tea or coffee.

Table 1: Rwandan Fertiliser Imports by Type, 2000

Fertiliser type	Tonnage	Percentage
NPK	3,767	58
Other fertilisers	2,505	38
Urea	221	3
Potassium Chloride	26	< 0.5
Sodium Nitrate	19	< 0.5
TOTAL	**6,537**	**100**

Source: Banque Nationale du Rwanda

5.2. Origins

Rwanda's imported fertiliser comes ultimately from a variety of world-market sources. Importers mention China, Jordan, Dubai, South Africa and Mauritius. However, the last of these accounts for over 95 percent of current official imports. Its predominance is due to the fact that this supplier is prepared to supply the relatively small orders of under 5,000 tonnes that Rwandan importers currently want. Most world-market exporters show little interest in such small consignments.

5.3. Price as a Function of Scale of Imports

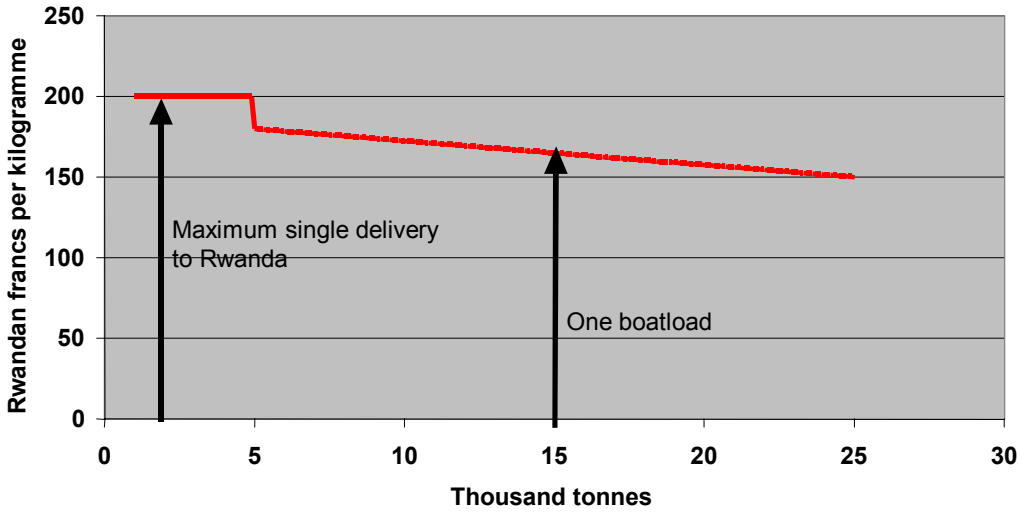
Rwanda's scale of operation is small and its costs of transport are high. Two Kigali wholesalers provided information that allowed figure 2 to be drawn. No single Rwandan shipment has exceeded 2,500 tonnes, which means that it is difficult to obtain a price of under 200 RwF/kg. Figure 2 shows no price for shipments of less than 1,000 tonnes because it is difficult to get quotes for such a small amount. Beyond about 5,000 tonnes, the price drops noticeably. As Rwanda's demand and volume of imports increase, it should be possible to get lower prices on the world market. Or a Rwandan importer could arrange a joint venture with another East African importer who already enjoys economies of scale in order to move quickly down the curve, perhaps as far as being able to benefit from the bringing in a boatload of fertiliser to Dar es Salaam.

5.4. Transport from the Indian Ocean Port to Kigali

Until the 1980s, most formal-sector fertiliser imports from the world market followed a route through Kenya and Uganda to the north of Lake Victoria. It started at the port of Mombassa (Kenya) and consisted of a rail journey of 1000 kilometres to Kampala (Uganda) where a transhipment to lorries took place before a road journey to Kigali.

Since then, Mombassa has lost ground to Dar es Salaam as the preferred port for fertiliser bound for Rwanda from the world market. Rwandan-bound shipments now arrive at Dar es Salaam (Tanzania) and travel 900 kilometres by rail to Isaka (Tanzania) where a transhipment takes place for the 500 kilometre lorry journey to Kigali.

Figure 2: Variation of wholesale unit price of fertiliser with volume of transaction



A combination of charges, delays and bribery associated with port handling and the rail and road journeys determine which route offers the lowest-cost – and thus the preferred route for imports. The change in route preference may be largely explained by increased bribery and delays in Mombassa but also by investments and new port management at the Dar es Salaam port.

The other factor favouring Dar es Salaam is linked to Rwanda's lack of choice in the world market. On the small scale that formal-sector Rwandan importers currently want to order, competitive suppliers number two, based in South Africa and Mauritius. For both of these, Dar es Salaam lies closer than Mombassa, reducing maritime shipping costs.

In 2000, East African Community (EAC) countries introduced axle-weight limitations on lorries travelling along their roads. Kenya and Uganda appear to have enforced these more strictly than Tanzania, thus allowing haulage contractors operating in Tanzania to load their lorries more heavily than in the two other countries and thus offer lower trucking rates.

The axle-weight limitations reinforce the case for the extension of the Tanzanian railway system into Rwanda. A project to continue to Kigali the line from Dar es Salaam to Isaka has surfaced from time to time but this project has no firm backing.

5.5. Liberalisation

In the post-genocide period, two types of fertiliser dominated imports: subsidised fertiliser from the European Community (EC) and imports destined specifically for the tea and coffee parastatal organisations (mostly 25:5:5 and 25:10:10). As EC offered subsidised 17:17:17 fertiliser, this type dominated the fertilisers destined for the non-beverage crops. Rwandan customs imposed on fertiliser a customs duty of 5% and another tax (ICHA) of 15% collected by the internal revenue agents of the Rwanda Revenue Authority (RRA).

Three liberalising changes have taken place in the Rwandan fertiliser market over the last few years. Firstly, the subsidy on EC fertilisers dropped from 50 to 0 percent between 1995 and 1999. Secondly, the tea and coffee parastatals – which had done their own importing – began using the National Tender Board to obtain their imports from the private sector. Thirdly, in the 1999, the government decided to withdraw completely from the fertiliser trade and made a clear policy statement that the business would thenceforth be left to the private sector, i.e. traders, producers' associations and co-operatives.

In keeping with this policy change, the government took two concrete steps to actively promote the private sector. It endorsed the Agricultural and Rural Market Development Project – designed to increase the involvement of the private sector in the distribution of agricultural inputs – and which began in January 2000. Then, in May 2000, it removed customs duty and ICHA (a tax replaced by VAT since January 2001) on fertiliser. These tax exemptions are initially for three years but may be extended for a further two years by presidential decree.

Wholesale traders now import all fertiliser used in Rwanda. Research revealed no exceptions to for fertiliser imported to meet the needs of parastatal organisations, NGOs, projects, co-operatives, associations and individual farmers.

The Formal-Sector Importers

Formal-sector importers must register with the Ministry of Justice and, when they want to import, apply for import licences from the National Bank of Rwanda (the central bank) via their commercial bank. Each import licence carries details of the type of merchandise, its mass, and the value of the proposed shipment. The import-licence procedure allows statistics to be collected and also planning for the allocation of foreign exchange. The contents of shipments with a value of more than US$ 5,000 must be inspected by a Swiss firm, *Société Générale de Surveillance* (SGS). When the shipment arrives at the Rwandan border the customs register it and then it proceeds to the *Magasin Générale du Rwanda* (MAGERWA) for verification before being released for internal consumption.

Formal-sector imports arrive directly from the world market, often partially financed by bank credits. Formal-sector importers paid import taxes during periods when government applied them to fertiliser. In the 1997-98 period, volumes of import consignments have typically been of the order of several hundred tons but 2000 saw three consignments of over a thousand tonnes. These importers tend to unload their deliveries in Kigali for sale there to distributors and retailers. They have bases in Kigali and, to date, no branches elsewhere. They may either import speculatively

for sale to all-comers; or they may import after having won tenders, typically from a parastatal organisation or an NGO.

In the past, companies specialising in agricultural inputs, such as Africhem, Agrophar and Agro-tech have imported fertiliser, though they have not done so in large quantities in the post-liberalisation era (Africhem 272 tonnes and Agrotech 0.9 tonnes in 2000). In contrast, importers in 2000 have included Murenzi Supply, with a commercial history built around transport and construction and, in 2001, GEGI, another company without a history in this trade. Regardless of their history, all these companies appear interested in the market. Those who have not imported in 2000 clearly have contacts in the world market and are considering committing themselves. None of these importers appears to have significant problems in obtaining information needed to do business in the world market, or at least in the limited part of it in which they can hope to operate.

Murenzi Supply has provided some of its recently-imported stocks (800 tonnes) to Africhem and to GECI for resale. It is not clear whether, on the one hand, this was a pre-arranged deal between commercial collaborators to enable the trio to spread the risk of not being able to sell relatively large stocks – and, perhaps, to influence prices – or, on the other hand, it represents two separate pragmatic deals that happened after the imports had arrived in-country. In either case, these sales suggest that there is some doubt among the formal importing community about how quickly one can move lots of over 500 tonnes of fertiliser. Importers are well aware of the seasonality of fertiliser demand so that, if they import too much or bring it in at the wrong time of year, they may be left with storage and capital costs over several months that may seriously erode their profits. Perhaps not surprisingly, these importers want government policy to change to increase demand. Murenzi Supply wants to receive the same treatment as NGOs from the World Bank's Agricultural and Rural Market Development Project (ARMDP) in being able to receive help to provide agricultural extension services and thus develop relations with farmer-clients. At the same time, Murenzi Supply recognises the need to train its own staff in fertiliser use and management. And all companies would like credit.

Some of these companies have tight downstream links to regional formal-sector retailers whom they supply but none has a branch outside Kigali. However, Murenzi Supply claims to intend to set up branches elsewhere, starting in Ruhengeri. In the other direction, none of the formal-sector importers has established an upstream link with regional importers in, say, Nairobi who already import from the world market on a much larger scale than any Rwandan importer. However, Murenzi Supply is currently researching the possibility of a joint venture with such companies.

Conscious of uncertainty about demand for fertiliser on the part of the formal-sector importers, the World Bank has set up a bank-credit guarantee scheme to encourage them to import through ARMDP. An arrangement brokered by the World Bank allows the National Bank of Rwanda to make available foreign exchange for fertiliser imports that the commercial banks allocate to their clients at preferential rates: 9 percent c.f. the normal rate of 16 percent. For the first shipment, the importer must provide a guarantee for 30 percent of the sum to be borrowed to import the fertiliser; the scheme covers the remaining 70 percent. For the second shipment, the importer provides 45 percent; for the third, 55 percent; etc. The scheme is designed to wean the importer

off credit guarantees as he builds up confidence in the profitability of importing fertiliser. The scheme lasts for 3 years and has a fund of US$ 2 million.

Initially, banks were slow to make the guaranteed loans available. Explanations given for this delay include: the fact that banks may not consider loans at 9 percent particularly profitable and the unwillingness of the central bank to provide the foreign exchange. Whatever the exact reasons may have been, the system is in place for the next two years, the initial lag seems now to have been overcome, and the importers themselves seem confident that future delays will be significantly shorter.[27]

The Informal Sector

The policy changes have promoted the growth of a type of importer that may not have been foreseen: the informal-sector importer. These importers seem not to have been in the formal fertiliser-import business before May 2000 (when the taxation on imported fertiliser was reduced to zero). But they appear to have seen a market niche and moved into it.

Three informal-sector importers appear to collectively import an estimated annualised total of 2,000 tonnes of various types of fertiliser. In February 2001, 17:17:17 of two types ("Osho" and "Mbolea"), MAP from Japan, and Urea from Romania were found on sale.

The niche exploited by the informal-sector importers depends on a combination of factors. Firstly, the demand for fertiliser in northwest Rwanda, at one stage removed from the formal-sector operators in Kigali, leaves a demand that was arguably not being well served. The informal importers are based in Ruhengeri, in the heart of the northwest, at a crossroads and close to the Ugandan border. Their presence has turned Ruhengeri into Rwanda's lowest-cost centre for fertiliser and its biggest fertiliser market outside Kigali.

Secondly, these importers buy not on the world market but mostly in Nairobi where, although they buy relatively small quantities from middlemen who take their cut, they can benefit from the low price that Kenyan middlemen can offer because they buy in much larger quantities than any Rwandan importer can currently dream of. The importers ship their fertiliser through Uganda[28] directly to Ruhengeri rather than Kigali. These consignments enter the country via the Cyanika customs post 28 kilometres northeast of Ruhengeri Town. The journey from Nairobi takes three days and importers do not report no special difficulties on the roads nor with demands for bribes at either border the lorries cross or along the way within Kenya, Uganda or Rwanda. There is one important and recently-instituted exception: enforcement of the axle-weight limit on lorries in Kenya and Uganda has added extra costs to this journey. In practice, one importer said, lorry

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[27] ARMDP is a project meant to provide "learning and innovation" over three years. One of its roles is to blaze a trail into new territory. In this context, getting the bank credit scheme in place represents at least a partial success. The real test will be the extent to which it now facilitates significantly increased imports.

[28] Note that little, if any, of their fertiliser comes *from* Uganda which, on average, uses less fertiliser than Rwanda.

loads are now limited to 25 – 30 tonnes, compared with 45 – 50 tonnes a year ago before the restriction was put in place adding significantly to transport costs.

Thirdly, importing through a customs post in northern Rwanda removes the need to spend time in the *Magasins Généraux de Rwanda* (MAGERWA) where the contents of imported shipments are checked. Those importing to Kigali cannot avoid this step, which typically takes a fortnight and costs 4 percent of the value of the consignment. Avoiding delays and marginal extra costs are two ways that the informal-sector importers keep costs low. Another is ensuring, when possible, that their cargoes do not exceed a value of US$ 5,000, in which case the Société Générale de Surveillance (SGS) does not need to inspect the shipment in Nairobi. Each such inspection avoided represents a monetary saving and, probably more importantly, a day's wait.

Fourthly, the informal-sector traders recently established in Ruhengeri have a different business culture from the older, formal-sector companies located in Kigali. The Kigali-based importers have well-finished offices and a mostly Francophone business environment. In contrast, their Anglophone Ruhengeri counterparts have rudimentary "cash and carry" warehouses to keep overhead costs low.

Fifthly, the absence of taxation of fertiliser imports means that they can run a legal business that does not pay tax at the border. Smuggling of fertiliser doubtless took place to a greater or less degree before the taxes were removed (though there is no indication that today's informal fertiliser importers were involved in smuggling). It would have involved risks about which these importers do not need to worry. Running a business based on smuggling and on a scale similar to that in which they are now engaged would have attracted attention.

Informal-sector imports arrive from neighbouring countries and Kenya, financed mainly by working capital and credit from within the informal trading community. It seems that these businessmen do not have credit ratings with Rwandan banks. This may be because they have yet to build up relations with these banks. Alternatively they may have seen no advantage in such banking relations if their working capital is shipped back to Nairobi in one or two days with an employee trusted to purchase the next load – because the combination of delays and cost that a Rwandan bank would impose in providing the same service seem unlikely to provide a superior solution. Nonetheless, the largest of these traders clearly wanted access to formal banking credit which, he believed, would allow him to increase his turnover. They may have better banking relations in Uganda or Kenya, or perhaps financing from Kenyan suppliers. Their lack of banking relations within Rwanda limits their ability to respond to tenders and probably contributes to their lack of bidding for tenders from the tea and coffee parastatal organisations.

These importers have spent time in East Africa and are Anglophone. It seems that one or two of them may have Ugandan nationality. At least one informal-sector, Ruhengeri-based importer also imports rice, wheat flour and salt. In these ways, they also differ from the Kigali-based formal-sector traders.

Estimates of the import flow from the three principal informal importers suggest that they collectively account for an annualised flow of about 2,000 tonnes. Figure 1 shows that flows of this rate would currently give them just over 20 percent of the Rwandan market.

A relatively large-scale informal importer provided the following information on his trade. He buys bagged NPK of South African origin in Nairobi at one of several suppliers that he uses there. He pays $320/tonne in cash; the supplier gives him no credit. He pays $100/tonne in transport to bring it to Ruhengeri where he sells it at 9,800 – 10,000 FRw per bag, depending on the volume that the purchaser wants. This yields a profit margin in the 4.4% – 10.7% range depending on:

- how much he sells at the lower price (the most important factor)
- the exchange rate used
- his transaction costs (storage, labour, etc.) and taxes paid in Ruhengeri.

He keeps the value of his individual shipments to under $5,000 to avoid having to submit his cargo to SGS inspection at a cost equivalent to 60,000 FRw and a delay of one day.

He has an average turnover of 1,700 – 2,000 bags monthly, or about 1,100 tonnes annually which is of the same order of magnitude as the formal-sector importers in Kigali. When interviewed he claimed to have 400 bags in stock and 880 bags in two lorries en route from Nairobi. However, he added that his stocks have tended to run out during periods of peak demand: January-February and September-October.

His Nairobi suppliers can provide NPK from Romania and Mauritius, as well as MAP from Japan, urea from Romania and DAP. His ambition was to be able to import directly from the world market, like the formal-sector importers in Kigali. He would then bring in via Tanzania DAP and MAP, which local potato producers mix with NPK to optimalise their yield increases.

Those in the formal-sector supply chain allege that suppliers such as this one sometimes import poor-quality fertiliser that does not correspond to the labelling on their sacks. For instance, the fertiliser may be of a different mix or unable to dissolve easily. This may have been a problem in some cases, but some of these may be interpreted as due to an unfamiliarity with different, e.g. slow-release, fertilisers by a sector that has grown quickly over the last few years and seen a range new traders entering the market, not always with a sufficient grasp of their wares. These problems in a small number of cargoes should not obscure the fact that, in the vast majority of cases, the informal sector can generally provide lower-cost fertiliser of an acceptable quality to the Rwandan market. Government projects and international NGOs have apparently recently bought large quantities of fertiliser (up to 240 bags at a time) from the informal sector despite these allegations from some quarters of poor quality.

In addition, at least one other quite separate informal-sector import system exists in Rwanda. A trader in Mugasomwa (Gikongoro Prefecture) in the south of the country receives shipments from Burundi. Gikongoro is often estimated to be Rwanda's third prefecture for fertiliser consumption. It seems that informal exports from Burundi depend on civil servants who illegally redirect loads of fertiliser destined for use in that country to the private sector which, in turn, clandestinely exports it. There is, of course, no import duty to pay. The recent low value of the Burundian franc relative to the Rwandan franc has favoured such flows. Burundian exports

comprise the commodity imported from the world market (in the original sacks) and have so far been untainted by suggestions of poor quality.

One informant maintained that informal flows also take place from Tanzania to Rwanda but no evidence for these was found. If they exist, it seems probable that they would take place from the main border crossing point at Rusumu, involve some means of avoiding MAGERWA in Kigali, and directing the flow to local sales outlets. However Rusumu is in Kibungo Prefecture, generally acknowledged to be a low user of fertiliser, with the exception of the area around Rwamagana Town. Therefore it seems that such flows would be low, if indeed they exist.

Formal-sector importers accuse their Ruhengeri-based competition of "unfair competition" because of the business model described above. In addition, they suggest that, by avoiding the MAGERWA, informal importers deprive Ruhengeri's Rwanda Revenue Authority (RRA) agents who collect the business tax (*impôt*) of information on the scale of their trade and that informal-sector importers can thus declare a lower business turnover than they really achieve. However, the turnover declared during interviews with the informal-sector corresponds to the figures verified by the DRSA at the customs post, and the DRSA strongly doubted that those in the informal sector could avoid paying the appropriate business tax. Others have suggested that informal-sector operators smuggle through customs dutiable goods under cover of a commodity exempt from import tax.[29] Indeed, the implicit nature of informal business makes it difficult to counter such allegations. On the other hand, no evidence of wrongdoing has emerged to date.

5.6. Re-exports

Informants differed on the extent to which Rwanda exports fertiliser to DRC. Some insisted that such exports exist from northwest Rwanda. However, traders and the DRSA/Ruhengeri claim that these do not take place. Consensus is that DRC uses little fertiliser, that traders may import some fertiliser into DRC via Burundi and/or Uganda but that little or none passes through Rwanda, and that re-exports are therefore minimal.[30]

5.7. The OCIRs

The parastatal *Offices de Cultures Industrielles du Rwanda* (OCIRs) provide fertiliser to Rwanda's tea and coffee sectors. They play a significant role in determining volumes of fertiliser imported into Rwanda.

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[29] Such behaviour appears to take place in other areas. For instance, Rwanda's imports of salt, zero-rated for the purposes of customs duty, seem to far exceed the needs of the population. Rwanda Revenue Authority figures show that, in December 2000, 2,089 of 10,110 tonnes (21 percent) of imports comprised salt. In January 2001, the corresponding figures were 2,242 of 6,028 tonnes (37 percent).

[30] Congolese farmers use urea on tobacco in Upper Congo (near Bunya and Mahagi) but Ugandan suppliers take care of this need.

5.1.1. OCIR-Thé

OCIR-Thé provides technical support and marketing services to the tea sector. It imports fertiliser destined for its plantations (30 percent) and out-growers (70 percent). In 2000, it imported four types of fertiliser totalling 5,000 tonnes, as detailed in table 2. In 2001, OCIR-Thé proposes to buy 4,800 tonnes of 25:5:5, which is the optimal for tea under most Rwandan growing conditions.

Table 2: OCIR-Thé: Details of Fertiliser Procurement in 2000

Fertiliser	**Tonnage**	**Price range** (RwF/kg)
25:5:5	1,500	144 – 151
20:10:10	2,500	144 – 151
20:5:5	500	158
KCl	500	167 – 172
Total	**5,000**	

Source: OCIR-Thé

Until recently, OCIR-Thé procured its fertiliser itself. It now uses the National Tender Board to perform this task through a tender system, with salutary results: the Technical Director notes that prices have since dropped from US$ 420 to 380 per tonne (177 to 160 RwF per kilogramme). Tea growers do not currently buy extra fertiliser (i.e. beyond what OCIR-Thé provides) to enhance productivity because:

- they cannot easily find appropriate fertilisers (especially 25:5:5) on the market
- partial substitutes cost much more than the fertiliser OCIR-Thé supplies to them at cost (at about 170 RwF per kilogramme).

Indeed, in some cases they actually divert some of the fertiliser destined for tea to other crops, such as potatoes and rice.

The Technical Director estimates that, for optimal profitability in Rwanda's tea sector, if available funds did not limit OCIR-Thé's fertiliser purchases, it would buy 15,000 –20,000 tonnes for the current area planted to tea. The upper figure corresponds to a projected optimal dose of 2.0 tonnes per hectare for the existing 10,000 hectares planted to tea.

Even at 5,000 tonnes annually, OCIR-Thé has a fertiliser-storage constraint. To get a low price, it buys in one big lot that arrives during the long dry season, ready for the two rainy seasons to follow. However, it does not have the storage capacity for this volume and currently borrows unused warehouse space from OCIR-Café. Some solution to this problem will have to be found if significant expansion in OCIR-Thé fertiliser imports is to take place.

Increases in the area under tea would require additional purchases of fertiliser. Currently, however, factory capacity is on the verge of limiting expansion of tea production. New

production lines in existing factories, which would take up to a year to construct, could ease the constraint in the short run.

5.1.2. OCIR-Café

OCIR-Café plays a similar role in the coffee sector to that which OCIR-Thé assumes in the tea sector, except that it neither runs plantations nor provides marketing services. OCIR-Café has less working capital and access to credit to finance fertiliser purchases for coffee farmers. In 2000 it was able to buy only about 400 tonnes of a planned 800 tonnes. This figure falls far short of the figure of 3,200 tonnes that OCIR-Café's technical service calculates that farmers could absorb. In comparison, Burundi's coffee farmers used about 2,000 tonnes in 2000. At the economically-optimal 1.0 tonne per hectare over the current area under coffee, estimated at 26,000 hectares, Rwanda's coffee farmers would clearly need 26,000 tonnes. However, financial constraints persist and, in 2001, OCIR-Café aims to supply only 600 tonnes to coffee growers.

20:10:10 is the optimal fertiliser for coffee in Rwanda under most circumstances. In the first half of 2000, OCIR-Café sold at 100 RwF/kg a remaining supply of 20:10:10 that it had obtained in 1999 at subsidised prices. In the second half of the year, its sales price rose to 150 RwF/kg, which comprised a cost price of 180 RwF/kg, plus the cost of transport to the farmer, minus a subsidy.

5.8. Conclusions

After a period of low fertiliser imports following the government's liberalisation measures, private-sector adjustment to new market opportunities has begun to take place. However, at least some formal-sector importers remain hesitant because of the initial problems of the bank-credit guarantee scheme and fundamental doubts about the profitability of fertiliser in Rwanda.

Formal-sector importers accept the delays and costs of transport and handling as part of doing business; and they believe they are well informed on world and regional markets. They are more concerned about the risk of poor-quality shipments and the possibility that informal-sector operators may be outmanoeuvring them. Stated priorities for formal-sector importers are staff training and outreach to clients in the form of participation in fertiliser extension to farmers. One such importer intends to set up regional branches; the others appear to be content to let their clients come to them from the provinces.

After initial slow progress towards implementing the World Bank's credit-guarantee scheme for fertiliser imports, the National Bank of Rwanda and the commercial banks involved seem to have resolved the problems and be moving towards using a greater proportion of the funds available for this process.

In contrast, informal-sector importers have blossomed in the provinces, where they are based. They have found a growth niche in the liberalised market and, in a rough and ready way, have exploited it vigorously over a period of months. Particularly in Ruhengeri, they find themselves at the crossroads of the northwest where most of Rwanda's growing demand for fertiliser lies. They may have no immediate incentive to set up Kigali-based offices.

The informal sector provides Rwanda with a diversified source of supply and its suppliers seem able to provide the northwest with the cheapest fertilisers in the country. These factors are clearly good news for Rwanda. The downside is the threat of inferior product quality. However, it seems unlikely that this is partly illusory, due rather to a lack of familiarity with the characteristics of a range of different types of fertiliser. To the extent that informal-sector importers have imported shoddy goods, this would appear to have been a mistake, rather than an attempt to swindle customers. It seems unlikely that informal-sector traders – having seen the damage that poor quality can do to a trading reputation – will easily allow tainted products to continue to enter the market.

As a final comment, MINAGRI's marketing manpower equals one person. Thus it is not surprising that the ministry's awareness of what's going on in fertiliser import markets is limited. In addition, it became clear in the course of fieldwork for this study that DRSA staff do not know much about private-sector fertiliser operations outside those run by co-operatives and associations.

5.9. Recommendations

Now that the credit-guarantees scheme's teething troubles are apparently over, ARMDP should continue to monitor its success.

ARMDP should help Rwandan importers if they want to find joint-venture partners elsewhere in East Africa. This strategy could reduce the cost of fertiliser by enabling Rwandan operators to share the benefits of existing economies of scale.

ARMDP (and eventually its successor World Bank project, the Rural Sector Support Project) should explore the possibility of working with informal-sector traders, particularly in Ruhengeri.

MINICOM should provide quick and easy testing of fertiliser composition, perhaps as part of its bureau of standards to be set up in the near future, in order to allow resolution of any questions of suspicious shipments. Both formal and informal-sector importers should welcome this: it would provide a means of market transparency and the basis for dispute resolution.

MINAGRI should set up a division dedicated to agricultural inputs, within which monitoring of imports should be an initial priority. Over the course of its remaining two years, ARMDP would gradually transfer its monitoring to this ministry division. The division would have responsibilities that would include establishing and maintaining contact with importers and prospective importers, their clients and the MINICOM office of standards. In the context of information about world-market developments, it would provide monthly reports to the public and private sector on fertiliser flows. It would also feed information on price and availability of different types of fertiliser and other inputs into a weekly radio-broadcast information system that would reach traders and farmers.

6. Agricultural and Rural Market Development Project: Explanatory Note

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Some of the factors limiting Rwanda's agriculture are limited availability of agricultural land and deteriorating soil fertility. In order to increase agricultural production given many other constraints in the agricultural sector, new strategies have been adopted to achieve this goal.

One of the strategies adopted by the Ministry of Agriculture, Animal Resources and Forestry is to shift from the past narrow approach of food self-sufficiency, characteristic of subsistence agriculture, towards greater market-oriented agriculture. The new strategy intends to increase agricultural production through intensification of input use, diversification and specialisation of farming systems.

It is within this framework that an Agricultural and Rural Market Development Project (ARMDP) is proposed to contribute towards sustainable increases in agricultural productivity and market development in rural areas so as to contribute towards food security and to reduce rural poverty through increases in agricultural revenues.

6.1. Project Objectives

The project's main objective is to contribute to the revitalisation of Rwanda's agricultural and rural economy by successfully identifying policies and institutional mechanisms to promote efficient private-sector based, local agricultural input distribution and output marketing systems in order to raise modern farm input use among farmers and thereby the productivity of labour and hence the level of incomes in the sector. Its specific objectives are to test alternative approach to:

- Facility access by farmers to credit for modern farm inputs;
- Provide technical advisory services to farmers on the use of modern farm inputs ;
- Encourage the emergence of a sustainable modern input system ; and to:
- Encourage investments by private traders in marketing services in rural areas.

6.2. Project Components

The proposed project would have the following three main components.

6.1.1. Promotion of Input Use and Distribution Systems

The specific objectives of these components are:

- to raise the supply of modern farm inputs in a sustainable fashion; i.e fertilisers, improved seeds, agro-chemicals, and livestock supplies ;
- to stimulate demand and facilitate access by farmers to these inputs.

Most farmers in Rwanda lack the resources to buy modern farm inputs when needed. Raising the level of input use fast enough and speeding up intensification therefore require institutional mechanisms that ensure sustained access to credit for modern farm inputs. The project seeks to achieve this through the following set of activities:

- Farmers access to seasonal credit for modern farm inputs:

    1. a **line of credit** to private importers of modern farm inputs, fertilisers, certified seeds, agro-chemicals, and livestock supplies that would provide to them the necessary resources and incentives to extend sales credit to farmers. The line of credit would also facilitate access to capital for modern inputs imports to a sufficiently large number of importers and thus promote competition in the sector.

    2. the creation of an **Inputs Credit Insurance Facility** (ICIF) that would make term credit available to farmers for the repayment of seasonal input credit in case of productions shortfalls that are due to weather or similar emergency situations. The facility would hence operate as an "insurance scheme" that would protect the nascent input-distribution system from potential shocks that might set back its development in its early stages. The facility would be funded through an initial contribution of the equivalent of $ 100 000 by Government and through the revolving funds generated from the repayment of the loans to private importers under the line of credit for the import of modern farm inputs.

    3. the establishment of a **Small Farmer Input Credit Facility** (SFICF) to promote farmer co-operative lending activities for poor farmers and farmer groups, especially those in remote areas who may not be able to have access to bank lending or sales credit by traders. This component would provide grants to these poor farmers through their co-operatives for the establishment of revolving credit funds to finance the acquisition of modern farm inputs.

- Advisory services for the adoption of modern farm inputs and access to credit to farmers, specialised local organisations and producer groups. Training and demonstration activities would be used to raise farmers' technical know-how about the use of modern farm inputs, thereby raising their profitability and encouraging adoption. In addition, support would be provided with respect to the access, use, and management of credit for modern farm inputs in order to reduce repayment risk and sustain access to loans.

- Multiplication and distribution of improved seeds: Targeted technical training and advisory services support, using specialised local organisations and producer groups, in order to encourage farmers to engage in seed multiplication, and traders in seed distribution, across local markets.

6.1.2. Support to Local Agricultural Marketing Systems

This component's specific objectives are to:

- encourage farmers to enter the market exchange system; and
- to improve the performance of local markets in the rural areas through the following activities:
    1. crop conservation, processing, and marketing technologies through:
        - training, using specialised non-governmental and other local organisations to promote improved crop conservation and marketing techniques among farmers;
        - funding of R&D activities to develop, test, and disseminate adapted crop processing technologies.
    2. strengthening of rural agricultural marketing poles through:
        - grants and institutional support to local communities for the improvement of basic marketing infrastructure, which would create the incentives for supplementary investments in storage and other marketing infrastructure and equipment by private traders. This activity would include institutional support to local communities to strengthen their capacities to effectively manage the rural marketing sites and to private traders to raise their management skills; and
        - support to private trader investment in marketing services through technical and institutional support to traders and producer groups to facilitate their access to and management of credit from local banks for investment in infrastructure and equipment for storage, processing, transport, and marketing of agricultural products.

6.1.3. Technical Support, Monitoring, and Evaluation

The main tasks under this component are to:

- work with local organisations and specialised NGOs to provide effective technical support to beneficiary groups ;
- manage project funds, including the handling of request for funding from beneficiaries, and
- organise the updates of the baseline surveys and gather other necessary information to closely monitor and evaluate the project's output and outcome.

6.3. Expected Output

It is expected that the quantities of modern inputs used by beneficiary farmers will be 25 %, 50 % and 75 % higher than the baseline average in the 1st, 2nd, and 3rd year respectively while the number of modern input importers will increase by 50 %, 75 % and 100 % in the 3 years of the project life. It is hoped that agricultural production will increase in proposition to increased input use.

6.4. Financing

The Project will be funded from a loan from International Development Association (IDA) equivalent to three million eight hundred thousand special drawing rights (3 800 000 SDR or US $ 5 000 000 approximately). The loan will be paid with 40 years and will have a grace period of 10 years at 0.75% of service fees.

Table 1: Indicative Project Costs

Component	Indicative Costs (US $ M)	% Total	Bank-Financing (US $	% of Financing
Promotion of input use and distribution systems.	3.29	59	3.03	61
Support to local agricultural marketing systems.	1.77	32	1.56	31
Technical support, monitoring, and evaluation.	0.55	9	0.41	8
TOTAL	5.61	100	5.00	100

Note: The total project cost includes beneficiary's contribution. The government of Rwanda cash contribution is equivalent to 371,600 US$

6.5. Duration

The project started in January 2000 and will close on June 30, 2003.

6.6. Implementing Agency

The Ministry of Agriculture, Animal Resources and Forestry and the National Bank of Rwanda.

7. Fertiliser Sector in Other East African Countries: Experiences in Development

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Agriculture is the dominant sector in the economies of Kenya, Tanzania, and Uganda. It is a major source of employment (providing employment for 80% of the labor force in both Tanzania and Uganda), a key contributor to the gross domestic product (GDP) of each country (e.g., 60% of GDP in Tanzania) and major foreign exchange earner. Clearly, economic growth in each of the three East African countries is heavily dependent upon agricultural sector performance. However, low agricultural productivity and resource degradation are severe in all three countries. Cereal yields of less than 1 mt/ha are common.

In order to increase rural incomes and meet the rapidly increasing demand for food, improved agricultural productivity is required. Empirical evidence substantiates that judicious use of fertilizers is key to achieving sustainable increases in crop yields. It is estimated that one-fifth to one-third of incremental agricultural production can be attributed to fertilizer use. The application of inorganic fertilizers is low and quite varied in these countries with total nutrient use in Kenya, Tanzania, and Uganda in 1999 estimated to be 127,600 mt, 27,826 mt, and 1,860 mt of nutrient, respectively. The intensity of fertilizer use is extremely low, estimated to be 32 kg, 8 kg, and less than 1 kg of nutrient per hectare of arable land in Kenya, Tanzania, and Uganda, respectively (Table 1, Figure 1). The world average is 100 kg of nutrient per hectare.

The low level of fertilizer use in Kenya, Tanzania, and Uganda is having long-term consequences for agriculture as evidenced by the deteriorating status of the soils. Soil nutrient removal in each of the three countries exceeds 60 kg/ha/year (Figure 2). The government of each country seeks to improve fertilizer use. The donor community (e.g., United States Agency for International Development [USAID] and Japanese International Cooperation Agency [JICA]) and nongovernmental organizations (NGOs), e.g., Sasakawa Global 2000 [SG2000]) have devoted varied attention in each country to improving farmer access to and the use of fertilizers.

The changing roles of government and private sector in the fertilizer subsector in Kenya, Tanzania, and Uganda and understanding the evolution of the fertilizer marketing system in each country offer useful lessons to other countries, particularly neighboring countries in Africa, which are seeking to improve the use of inorganic fertilizers. While policies in each of the three countries have generally been consistent with market-economy concepts, the private-sector response (in terms of investment in the fertilizer market) has been varied.

The purpose of this paper is to improve participants' understanding of the:

1. Evolution of the fertilizer marketing systems in neighboring East African countries.
2. Key factors and events involved in the fertilizer market development process.

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3. Present status of the fertilizer market in each country.
4. Lessons learned from the development experience in Kenya, Tanzania, and Uganda and opportunities for regional collaboration to facilitate improved efficiency of the fertilizer marketing system in Rwanda.

Table 1. Fertilizer Use Per Hectare of Arable Land, 1998/99

Country	Fert. Consumption (mt)	Arable Land ('000 ha)	Fertilizer Use (kg/ha)
Algeria	95,800	7,661	12.5
Angola	5,200	3,000	1.7
Benin	37,707	1,700	22.2
Botswana	4,200	343	12.2
Burkina Faso	50,232	3,400	14.8
Burundi	2,073	770	2.7
Cameroon	39,533	5,960	6.6
Central African Rep	600	1,930	0.3
Chad	16,820	3,520	4.8
Comoros	300	78	3.8
Congo, Dem Rep	0	6,700	0.0
Congo, Rep	5,000	173	28.9
Côte d'Ivoire	113,400	2,950	38.4
Egypt	1,112,652	2,834	392.6
Eritrea	6,500	498	13.1
Ethiopia	164,242	9,950	16.5
Gabon	400	325	1.2
Gambia	1,500	195	7.7
Ghana	15,140	3,600	4.2
Guinea	3,284	885	3.7
Guinea-Bissau	600	300	2.0
Kenya	**127,600**	**4,000**	**31.9**
Lesotho	6,000	325	18.5
Liberia	0	190	0.0
Libya	50,300	1,815	27.7
Madagascar	8,677	2,565	3.4
Malawi	50,200	1,875	26.8
Mali	52,623	4,606	11.4
Mauritania	2,100	488	4.3
Mauritius	33,100	100	331.0
Morocco	350,400	9,033	38.8
Mozambique	5,035	3,120	1.6
Niger	930	4,994	0.2
Nigeria	188,300	28,200	6.7
Rwanda	300	820	0.4
Réunion	5,600	33	169.7
Senegal	26,800	2,230	12.0
Sierra Leone	3,000	484	6.2
Somalia	500	1,040	0.5
South Africa	782,600	14,791	52.9
Sudan	37,500	16,700	2.2
Swaziland	5,500	168	32.7
Tanzania	**27,826**	**3,750**	**7.4**

Country	Fert. Consumption (mt)	Arable Land ('000 ha)	Fertilizer Use (kg/ha)
Togo	17,200	2,200	7.8
Tunisia	120,853	2,900	41.7
Uganda	**1,860**	**5,060**	**0.4**
Zambia	40,300	5,260	7.7
Zimbabwe	174,400	3,220	54.2
Sub-Saharan Africa	**1,282,082**	**138,699**	**9.2**
Africa	**3,794,687**	**177,733**	**21.4**

Source: FAO.

7.1. Overview of the Fertilizer Markets in Kenya, Tanzania, and Uganda

There are significant differences in terms of the size, structure, and emphasis given to development of the fertilizer markets in Kenya, Tanzania, and Uganda. As indicated in Figure 3, the trend in fertilizer use in Kenya exhibits a generally stable growth pattern, and the market is quite large relative to the markets in Tanzania and Uganda. While the long-term growth pattern in Kenya is generally favorable, the fertilizer market has experienced significant change during the past five decades. This change was largely a direct result of the Government of Kenya (GOK) policy regarding fertilizer marketing issues. Initially a private-sector oriented system, the GOK became heavily involved in the supply and marketing of fertilizer during the 1970s and continued to play a dominant role throughout the 1980s. During the period 1983-92, as a result of donor pressure, the market was gradually reformed; today the private sector accounts for essentially 100% of the fertilizer marketing activities in Kenya. Buoyed by a strong private-sector dominated cash crop sector, the fertilizer market transition did not result in a major decline in total fertilizer use.

The Tanzania fertilizer market has a (generally) similar history to that in Kenya. Throughout the 1970s and early 1980s, the fertilizer supply and marketing system was administered by the public sector. The market reform process began in 1983 and continued until the early 1990s at which time the Government of Tanzania (GOT) withdrew from fertilizer importation and marketing. The GOT maintained a substantial subsidy on fertilizers until 1993. Today the fertilizer market is fully liberalized, and the private sector accounts for essentially 100% of fertilizer imports and marketing activities. The fertilizer marketing system remains fragmented and dealer networks very limited. Total fertilizer use has stagnated. The weakness in the market reflects substantial instability and inefficiency in the Tanzania fertilizer marketing system, a weak/non-existent credit system, and unfavorable fertilizer:crop price relationships.

The evolution of the fertilizer market in Uganda differs significantly from that of Kenya and Tanzania. The importation and use of fertilizer was disrupted during the 1970s and remained very low until the late 1980s due to political instability and a widespread "belief" that the soils in Uganda were sufficiently fertile that use of inorganic fertilizer was not required. The benefits of the "Green Revolution Era" of the early 1970s essentially bypassed Uganda. Today a generation of farmers in Uganda till the soil with little experience in the use and benefits of inorganic fertilizer in crop production. As a result, the fertilizer market in Uganda is in a very early stage of development and aggregate use is extremely low, even by African standards.

7.1.1. Fertilizer Marketing in Kenya

Consumption Trends in Kenya

Inorganic fertilizers were first used in Kenya in the 1950s, initially by the estate sector. Fertilizer use by smallholders intensified following independence (1963), and largely due to several key factors (i.e., the introduction of hybrid maize, increased smallholder tea and coffee production, introduction of fertilizer subsidies, and general stability in international market prices) fertilizer use increased at a rate of 16.0%/year during 1962-72. In 1972 fertilizer consumption totaled 53,200 mt of nutrients, an absolute increase of 4,100 mt of nutrients per year during the period 1963-72 (Table 2).

The period 1972-84 was one of general upheaval in the Kenya fertilizer market. This was due to the rapid increase in world market prices (due to oil crisis), increasing transport costs, a general collapse in output market prices, the gradual phasing out of subsidies, and direct government intervention in the importation and distribution of fertilizers. During this period annual fluctuations in fertilizer use were significant, with national fertilizer use declining in 7 of 13 years during the period 1972-84. In 1984 fertilizer use in Kenya totaled 78,950 mt; hence a compound growth rate of only 33%/year. The absolute increase in fertilizer use during this 12-year period was 2,400 mt/year, or about 60% of the average annual growth in nutrient consumption during the previous period.

The period 1984-94 was the fertilizer market reform phase in Kenya. Donor activity in the fertilizer market (e.g., in providing fertilizer supply and in assisting the GOK with policy guidance) was substantial and key to a relatively smooth market reform process. During this period fertilizer use in Kenya increased at a rate of 5.1%/year or an absolute increase of 5,100 mt/year. The increase in fertilizer use was due to improved supply availability, increased private-sector activity in the market, and fertilizer price stability and recovered crop market prices.

During the period 1994-98 fertilizer use in Kenya fluctuated significantly, from 125,089 mt of nutrients in 1994—to 111,365 mt of nutrients in 1996—to 153,194 mt of nutrients in 1999 (Figure 4). The fluctuations in use are primarily due to drought and weakness in output markets (e.g., coffee). The continued depreciation of the Kenya shilling (KSh) has also resulted in higher fertilizer prices to farmers, thus creating a cost:price squeeze on farmers and a dampening effect on fertilizer demand.

Table 2. Fertilizer Nutrient Consumption in Kenya, 1962/63-1998/99

Year	N	P_2O_5	K_2O	Total
	(mt nutrients)			
1962	3,500	7,500	1,100	12,100
1963	7,324	7,532	1,166	16,022
1964	10,332	8,071	862	19,265
1965	13,000	10,178	846	24,024
1966	11,787	16,560	2,325	30,672
1967	13,000	17,500	2,800	33,300
1968	10,800	20,000	2,000	32,800
1969	16,000	23,900	2,400	42,300
1970	22,000	24,400	3,100	49,500
1971	18,500	25,600	3,100	47,200
1972	18,496	28,388	6,305	53,189
1973	20,370	28,000	2,592	50,962
1974	19,400	29,400	4,000	52,800
1975	21,882	20,227	2,385	44,494
1976	22,417	27,262	4,217	53,896
1977	25,284	21,196	5,042	51,522
1978	25,416	16,497	9,089	51,002
1979	20,100	10,200	8,000	38,300
1980	26,700	25,900	9,000	61,600
1981	37,000	40,000	5,800	82,800
1982	34,200	30,800	4,000	69,000
1983	31,000	49,100	6,700	86,800
1984	35,961	38,027	4,955	78,943
1985	57,530	43,749	7,837	109,116
1986	63,718	45,387	13,714	122,819
1987	45,883	50,265	5,795	101,943
1988	67,242	51,062	6,295	124,599
1989	45,000	62,000	9,800	116,800
1990	57,000	51,000	8,000	116,000
1991	54,300	54,430	5,624	114,354
1992	51,890	45,185	7,547	104,662
1993	62,524	57,344	5,262	125,130
1994	61,470	58,668	4,952	125,089
1995	61,086	54,730	8,441	124,257
1996	56,302	47,499	7,564	111,365
1997	52,429	57,324	6,264	116,017
1998	54,674	66,256	5,911	126,841
1999	81,561	61,947	9,686	153,194

Source: 1962-90 data, FAO; 1991-99 data, Ministry of Agriculture, Kenya

Fertilizer Market in Kenya

The fertilizer market in Kenya includes both a "strong" cash crop sector (wherein inputs are provided on credit to farmers and crop output market stability is favorable) and a relatively large smallholder sector (many of which produce cash crops). In recent years an estimated 60%-65% of the fertilizers used in Kenya are applied to cash crops (i.e., coffee [30%], tea [18%], sugarcane [16.5%]). Stability (price and market) of these markets has a major impact on fertilizer use in Kenya. In addition to engaging in production of cash crops, smallholders are the dominant maize producers; maize accounts for about 20% of the fertilizer market.

The fertilizer product mix used in Kenya has evolved based upon extensive research trials and the general global trend toward increased use of high analysis fertilizers (e.g., diammonium phosphate [DAP] and urea).[32] Key fertilizer products used in Kenya and their approximate market share are as shown in Table 3. Estimated fertilizer use by product for the years 1992-99 is presented in Table 4.

Fertilizer Marketing System in Kenya

As indicated earlier, inorganic fertilizers were first used in Kenya in the early 1950s. The initial use was on cash crops (e.g., coffee, tea, sugarcane, etc.). The estates organized their own import supply. A few private-sector importers imported fertilizers for resale to stockists. The GOK was not involved in fertilizer supply and marketing.[33]

Two major global events in 1973/74 resulted in turmoil in the world fertilizer market and precipitated immediate and significant changes in the Kenya fertilizer market. The two events were:

1. *The world food crisis and the "Green Revolution"* (which emphasized increased use of inorganic fertilizer to achieve increased yields) created a strong global demand for fertilizers.
2. *The world oil crisis* resulted in rapidly escalating production costs.

The combined effect of higher production (fertilizer) costs and increased demand led to an unprecedented increase in fertilizer prices on the international market (Figure 5). Supply shortfalls on the global market resulted in fertilizer shortages in Kenya and, when available, prices were at record high levels. In reaction to this global crisis (which was further fueled in Kenya by rumors of local "hoarding" and "price gouging"), the GOK intervened in the market with a series of actions that substantially influenced the Kenya market for the next 18 years. Included were:

1. Applying price controls on fertilizers in the form of fixing maximum retail prices (via a general price control order).
2. Beginning direct imports through the parastatal Kenya National Trading Organization (KNTC).
3. Petitioning the donor community for fertilizers to be provided as aid and distributed through the Kenya National Federation of Co-Operatives (KNFC).

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[32] DAP nutrient content is 18% nitrogen and 46% phosphate (expressed as phosphate pentoxide ([P_2O_5]); i.e., 18-46-0. Urea nutrient content is 46% N, i.e., 46-0-0.

[33] The GOK did approve a fertilizer selling price list, promote fertilizer use through extension activities, conduct fertilizer trials, and handle subsidy payments. The subsidy ranged from 4.4% to 14%, depending on the product.

4. Introducing a new import quota allocation system to enable the GOK to "manage" private-sector imports.

Table 3. Fertilizer Market Share by Product in Kenya, 1990s

Product	Estimated Market Share (%)
Urea	7
CAN	14
DAP	30
MAP	5
25-5-5+5S	20
Other NPK	10
Other	14

The GOK interventions had an almost immediate negative impact on the private sector. For example, the late GOK announcement of allowable selling prices created such uncertainties in the market that the private sector delayed/canceled import plans, thus further contributing to supply uncertainty in the Kenya market. Also during this time, the GOK introduced its first in a series of pricing schemes in an attempt to control profit margins. The initial scheme was to fix the price of donor aid fertilizer at 30% below the prices of commercially imported stocks. This action resulted in huge losses for the private sector (which had imported fertilizers on a full-cost basis and attempted to market the fertilizer in competition with donor-supplied inputs); many private firms were forced to withdraw from the fertilizer business during this time.

By the early 1980s the fertilizer market in Kenya, under heavy government control, was in disarray. The private sector, with the exception of only three to four firms, had withdrawn from the market; private-sector distribution networks collapsed. The Kenya Farmers' Association (KFA),[34] a government parastatal, accounted for an estimated 85% of all fertilizers marketed in the country; it was the sole recipient of donor-financed fertilizers.

[34] The former Kenya National Federation of Co-Operatives.

Table 4. Estimated Fertilizer Use by Product in Kenya, 1992-99

Type of fertilizer	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000
	(MT of product)								
Planting									
DAP	80,225	65,845	76,098	82,346	47,863	52,067	79,809	84,298	72,700
MAP	4,943	11,512	10,150	16,898	34,929	14,393	17,570	23,186	18,760
TSP	7,052	761	3,488	3,898	7,235	2,906	4,225	4,271	8,700
SSP	3	0	3,411	5,516	5,115	2,292	3,527	5,070	5,150
NPK 20:20:0	2,789	7,449	24,368	10,595	7,702	13,577	7,687	5,628	10,480
NPK 23:23:0	23,538	8,882	20,245	11,394	5,468	14,441	8,318	29,765	13,690
Planting	118,550	94,449	137,760	130,647	108,312	99,676	121,136	152,218	129,480
Topdressing									
CAN	28,248	31,680	36,194	38,733	43,614	32,843	28,858	28,274	56,904
ASN	5,578	2,851	3,581	6,744	2,430	2,025	500	1,330	6,606
Urea	9,471	14,926	23,036	20,716	18,505	14,020	13,273	14,900	32,468
SA	8,985	36	5,741	10,450	11,602	3,472	3,302	1,711	8,450
Topdressing	52,282	49,493	68,552	76,643	76,151	52,360	45,933	46,215	104,428
Tea									
NPK 25:5:5:5s	58,773	54,937	42,949	51,332	61,698	65,629	54,307	38,565	80,934
NPK 25:5:5:3.95s+2.6MgO	0	0	0	0	2,300	0	0	0	3,450
NPK 22:5:14	0	0	0	0	0	0	0	0	0
NPK 22:21:17	0	0	0	0	0	0	0	0	0
NPK 22:8:9	0	0	0	0	0	0	0	0	0
NPK 22:6:12+5S	0	0	0	0	0	0	0	0	0
Tea	58,773	54,937	42,949	51,332	63,998	65,629	54,307	38,565	84,384
Coffee									
NPK 18:4:12	0	8,818	646	6,991	5,122	4,445	8,727	8,464	6,365
NPK 20:10:10	7,791	7,514	21,123	7,359	10,533	11,709	7,161	3,441	12,044
NPK 17:17:17:	9,306	1,846	1,251	1,760	5,725	8,226	4,270	2,700	5,049
NPK 16:16:16		2,142	0	0	0	0	0	0	0
Coffee	17,097	20,320	23,020	16,110	21,380	24,380	20,158	14,605	23,458

Type of fertilizer	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000
	(MT of product)								
Tobacco									
NPK 12:2:43	0	0	0	0	645	0	0	0	0
NPK 8:16:24+MgO+0.1%B	0	0	0	0	3,500	0	0	0	0
NPK 15:15:6+4MgO+0.1%B	0	0	0	0	1,204	5,400	0	0	1,500
NPK 16:12:24	0	0	0	0	40	30	0	0	0
NPK 5:15:25	0	0	0	0	300	0	245	721	0
NPK 13:9:21+MgO	0	0	0	0	42	0	0	0	0
NPK 10:4.7:0.2	0	0	0	0	303	0	721	0	1,500
Tobaccco	0	0	0	0	6,034	5,430	966	721	3,000
Specialized									
MOP/SOP	0	3,298	0	429	1,057	18	91	653	695
NPK 19:19:19	0	0	0	0	83	107	60	1,783	2,115
NPK 19:19:19+M.E+1%MgO	0	0	0	0	454	313	12	2,056	2,567
NPK 28:28:0	416	0	0	549	916	3,145	0	230	900
NPK 14:36:0	0	0	0	0	256	1,079	416	198	585
CN	0	0	0	0	5,903	209	416	320	300
$MgNO_3$	0	0	0	0	5	5	10	164	150
Fetrilon Combination	0	0	0	0	16	6	462	941	402
AN	0	0	0	0	362	560	301	98	225
NPK 13:0:46	0	0	0	0	41	768	335	1,126	1,555
$MgSO_4$	0	0	0	0	80	0	100	1,094	970
Others	6,489	10,398	14,238	5,511	10,577	337	10,341	3,985	3,430
Specialized	6,905	13,696	14,238	6,489	19,75	6,547	12,544	12,649	13,894
Total	253,607	232,895	286,519	281,222	295,625	254,022	255,044	264,972	358,644

Policy Reform in Kenya

The year preceding GOK intervention in the fertilizer market, fertilizer use was estimated at 53,000 mt of nutrient. For the remaining 7years of the decade of the 1970s, use stagnated, with total consumption estimated to be 38,300 mt of nutrient in 1979. Following regular arrivals of aid fertilizers in Kenya in the early 1980s (thus improved supply availability), a favorable consumption growth trend resumed.

In the early to mid-1980s the GOK, reemphasizing the importance of agricultural sector performance to national economic development and food security, had the following key goals that influenced its agricultural policies:

1. Achievement of national food security.
2. Increased exports of agricultural products.
3. Providing agricultural raw materials for domestic industries.

The GOK's strategies for achieving its national goals were linked to the removal of constraints to agricultural production; improved use of fertilizer was recognized as the most important factor to increasing crop yields.

It was during the same period (early 1980s) that the donor community began to seek reform of the fertilizer market as key to improved efficiency (i.e., timely availability of fertilizer supplies of appropriate fertilizer products, reasonable prices, etc.). To spur fertilizer market reform, donor supplies were provided to the GOK on the basis of policy conditionalities. The timeline of policy changes and development-oriented actions, which were largely influenced under USAID during the mid to late 1980s, are indicated in Figure 6.

The primary intent of the policy reform initiatives was to improve the efficiency of the marketing system by eliminating barriers to private-sector investment. A brief comment on some of the key policy changes and development initiatives is useful to understand the transition from a government-controlled and -administered fertilizer subsector in Kenya to one that is now fully liberalized.

1984

1. **Cancellation of the GOK/KFA Sole Distribution Agency Agreement**—This action effectively opened up the market to increased private-sector participation in the fertilizer market in general and to the supply of donor aid fertilizers in particular. The donors (in the mid-1980s) supplied up to two-thirds (1998) of the total imports to Kenya; hence, having access to donor supplies was essential to private-sector participation in the market.

2. **Revision of Pricing Structure**—The GOK sought to control fertilizer prices through a pricing formula based upon "assumed" fair margins. In 1984, the fertilizer pricing structure was modified with the intent of providing private-sector firms a more reasonable financial incentive for making fertilizers conveniently and timely available to farmers while at the same time protecting farmers from excessive profiteering by marketers. Retail prices were fixed as maximum retail prices (MRP) using the simple formula:
3. C * 1.30 + 100 + T = MRP
   where

1.30 is factor to allow 30% markup
C = c.i.f. import cost (Mombasa, per mt)
100 = Ksh 100 markup to cover port costs
T = transport allowance

4. **Authorization for Surcharge or Small Bags**—Packaging of fertilizer in small bags was determined to be one approach to encouraging smallholders to use fertilizers. The "surcharge authorization" provided a financial incentive for marketers to repackage fertilizer in small (10-kg) bags. However, the methodology was oversimplified in that the price was calculated by dividing the 50-kg bag price by five, hence providing no financial incentive for the private sector to engage in rebagging activities.

5. **Payment for Aid Fertilizers in Cash/Bank Guarantees of 180 Days**—This deferred payment system enabled an increased number of private-sector firms to participate in the marketing of aid-financed fertilizers, creating access to credit.

6. **GOK Improved Timely Requests for Donor Fertilizers**—This action was to eliminate the many earlier inefficiencies in the GOK system of requesting/receiving aid fertilizers. Late arrivals occurred frequently in the 1970s and early 1980s, resulting in serious inefficiencies in the total supply and marketing system. As the GOK sought to increase private-sector involvement, increased emphasis was devoted to timely import arrivals, thereby enabling the private sector to improve planning and implementation of both import and domestic marketing programs.

1986

1. **Implementation of Benchmark International Pricing Formula (BIP)**—In an effort to simulate market-based pricing, the GOK developed the BIP scheme. The BIP was the estimated import procurement cost based on recent transactions on the global market.[35] The pricing models provided a clear, valid justification for the buildup of prices. It also improved the understanding of all regarding the many cost items involved in the fertilizer business.

2. **Created Fertilizer Monitoring Unit**—Established in the Ministry of Agriculture, this unit was created to monitor the national and international fertilizer situation and develop a fertilizer information system on requirements, prices, supply, etc. The unit was also involved in BIP pricing calculations.

1987

1. **Improvement of Fertilizer Demand Forecasting**—Recognizing the importance of a realistic national forecast of fertilizer demand to assuring adequate supply availability, the GOK initiated (through the fertilizer monitoring unit created in 1986) fertilizer demand forecasting activities.

[35] Transactions reported in the trade media (e.g., *Fertilizer International*, *Fertilizer Week*, etc.) involving large transaction between world-scale suppliers and buyers provided the basis for estimating the BIP.

1988

1. **Refinement of BIP Model**—The BIP model was evaluated and modified to reflect further realities of fertilizer importation and marketing in Kenya. Key refinements included (1) the addition of an allowance to protect importers against the depreciation of the Kenya shilling and (2) the timely update of the BIP to reflect changes in world fertilizer market prices (Figure 7). The use of the BIP model was a component of the GOK's overall policy as stated in the "National Policy for Fertilizer Pricing and Marketing," December 1987:

The main objective of the fertilizer policy will be to ensure availability of fertilizer when needed by farmers. The Government will seek to ensure that (a) there is no wastage of foreign exchange and (b) farmers do not pay unnecessarily high prices for fertilizers.

2. **Development of Educational Leaflets on Fertilizer Use**—In an effort to improve smallholder knowledge of proper fertilizer use practices, attention was devoted to publication in (Kswaheli) and dissemination of educational leaflets on proper fertilizer use management.

1989

1. **Improvement of Fertilizer Allocation Systems**—The import allocation system to allow private-sector firms to import specific quantities of fertilizer or receive donor-supplied imports was based upon the GOK inter-ministerial Fertilizer Allocation Committee's "evaluation" of requests for imports. However, late allocation (as well as price announcements) caused many private importers to defer imports to the point of creating severe supply uncertainty. The purpose of this action was to assure the timely allocation of fertilizer import (commercial and donor-financed) allowances.

1990

1. **Fertilizer Price Decontrol**—The GOK announced the complete decontrol of fertilizer prices (i.e., discontinuation of the BIP scheme).

2. **Removal of Import Quotas in Import Licensing**—This final action basically completed the GOK fertilizer market liberalization program, allowing private-sector firms to import fertilizers as per their individual requirements.

The GOK policy reform measures of the 1980s and early 1990s (albeit slow to evolve) effectively opened up the market to private-sector importation and marketing of fertilizers. It also allowed the GOK to reduce funding to the now defunct Kenya Grain Growers Co-Operative Union (KGGCU). As a result, fertilizer supply availability (timely supply of appropriate products) improved and prices were based upon actual costs and competitive pressures.

At present there are an estimated 8-10 active fertilizer importers in Kenya and 7,000-8,000 stockists during the major use season. In 1999 and 2000 total fertilizer use was estimated at 127,600 mt and 153,100 mt of plant nutrients, respectively. Fertilizer prices in Kenya are market based. With the exception of a small quantity of donor-financed fertilizers, there is no government intervention in the

fertilizer market.[36] Fertilizers are free of import duties. Value-added tax does not apply to imported fertilizer; it does apply to fertilizer transport and related costs within Kenya.

Being almost 100% dependent upon imports for fertilizer supply, domestic prices are heavily influenced by world fertilizer market conditions, ocean freight rates, and the stability of the Kenya shilling (as well as competition in the domestic market). In late 2000, gross margins at the retail level in Kenya were very low, at 3%-4%; urea and DAP prices were estimated at US $14.40 and US $15.75 per 50-kg bag, respectively.

7.1.2. Fertilizer Marketing in Uganda

Consumption Trends in Uganda

Fertilizer use in Uganda has traditionally been extremely low, increasing from a base of about 2,600 mt of nutrient in 1961 to about 7,700 mt of nutrients in 1972 (Table 5).[37] During the early 1970s, which is recognized as the "Green Revolution Era" in global agriculture, political instability in Uganda resulted in the benefits of this era bypassing Ugandan farmers. Rather, during the 1970s in Uganda there was a complete collapse of the fertilizer market; fertilizer use declined to less than 1,000 mt of nutrients per year during the late 1970s and continued at extremely low levels throughout the 1980s. During that period only nitrogen and phosphate (locally produced single superphosphate [SSP]) fertilizers were used; no potassium fertilizers were used during the 9-year period ending in 1987 (Figure 8).

Beginning with the 1990s, increased emphasis on agriculture (particularly a growing interest in agricultural production for export) contributed to a gradual recovery in the use of agricultural inputs, but

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[36] About 20,000 mt of fertilizer (mostly monoammonium phosphate) is provided annually under the Japan Kennedy Round 2 (KR2) program.

[37] The estimated use levels for years prior to 1997 are from FAO. The FAO figures are for commercial and donor imports and reflect "apparent" consumption. Statistics on actual fertilizer use in Uganda are unavailable. The FAO statistics are in mt of nutrient. Based upon the product mix used by Ugandan farmers, the product mix has changed over time from low-analysis materials such as ammonium sulfate (AS) and SSP in the 1960s-1970s to high-analysis materials in the 1990s. The average nutrient content today is estimated to be about 38%.

this emphasis has mainly been on improved planting materials. While recently there has been increased awareness of the need to restore soil fertility, at present it is estimated that inorganic fertilizer use in Uganda totals only about 6,800 mt of nutrients per year; 80%-90% of fertilizer use is by larger farmers/estates.

The fertilizer product mix in Uganda reflects the dominance of cash crops; specialty grade NPKs account for over 40%-50% of the total use of inorganic fertilizers.[38] Urea and diammonium phosphate (DAP)/triple superphosphate (TSP) account for about 25% and 9% of the market, respectively. The most commonly used NPK grades used in Uganda are shown in Table 6.

[38] Note: Specialty grade NPKs are typically manufactured to meet a specific order. The cost per unit of nutrient for specialty grades is higher than "commodity type" products such as DAP and urea. However, the specialty grade products are usually specific formulations targeted to specific horticulture crops and as such are in demand by producers of high value crops. Fertilizer products such as urea and DAP are normally the lowest cost sources of nutrient (for dry fertilizers) and are well suited to meet the N and P requirements of grains and vegetable crops.

Table 5. Fertilizer Nutrient Consumption in Uganda, 1963-1999

Year	N	P_2O_5	K_2O	Total
	(mt nutrients)			
1962	1,300	1,100	300	2,700
1963	1,500	1,200	500	3,200
1964	1,500	1,300	800	3,600
1965	1,864	1,500	1,000	4,364
1966	2,572	1,700	1,000	5,272
1967	1,709	1,327	740	3,776
1968	1,981	1,495	1,250	4,726
1969	2,220	1,150	1,200	4,570
1970	4,000	2,000	1,000	7,000
1971	4,400	2,500	1,200	8,100
1972	4,000	2,000	1,696	7,696
1973	4,000	2,400	787	7,187
1974	1,600	1,300	700	3,600
1975	872	660	157	1,689
1976	963	430	263	1,656
1977	300	500	300	1,100
1978		300		300
1979				
1980	700	100		800
1981	500	100		600
1982				
1983				
1984	400	100		500
1985	200			200
1986	262	126		388
1987	789	374	12	1,175
1988	107	12	12	131
1989	250	55	50	355
1990	92	100		192
1991	500	300	400	1,200
1992	400	100	300	800
1993	1,300	400	500	2,200
1994	1,000	400	500	1,900
1995	800	200	300	1,300
1996	200	200	200	600
1997	200	200	200	600
1998	1,260	300	300	1,860

Source: FAO.

Table 6. NPK Fertilizer Use in Uganda, 1998

Grade	Crop Fertilized	Approximate Quantity Used in 1998
		(mt of product)
8-16-24+2MgO+0.1B	Tobacco	2,100
25-5-5+5S	Tea	3,200
Various	Flowers	600

Fertilizer Market in Uganda

Although fertilizer use remains extremely low (even after a decade of market and policy reform in Uganda), the market appears to be on the threshold of rapid growth. This is reflected in increased use by commercial farmers, a "growing" fertilizer demand by smallholders, and increased "awareness" and emphasis among farmers as well as relevant Government of Uganda officials on the need for fertilizers.

Most of the fertilizers used in Uganda are applied to cash crops (e.g., tobacco, tea, and sugar) where acceptable returns from using fertilizers are being realized. Although, in comparison to neighboring Kenya, there are few commercial farms in Uganda, the area being brought into commercial crop production has increased substantially in recent years and further increases are in progress. During 1988-98 the area in Uganda planted to tea, sugarcane, and tobacco increased by 290%, 435%, and 280%, respectively.

Fertilizer is becoming increasingly accessible to smallholder farmers, due in large part to the efforts of the Ministry of Agriculture, Animal Industry, and Food (MAAIF)/SG2000, and USAID/Investment in Developing Export Agriculture (IDEA) projects. Both programs focus on improving farmers' *awareness* of agri-input technologies and *access* to the technologies and stimulating increased private-sector activity in fertilizer trade. In addition, smallholders are increasingly joining the production schemes of commercial farmers as outgrowers and as such have increased access to fertilizers and fertilizer use technologies (e.g., under the British American Tobacco (BAT) production scheme, an estimated 47,000 smallholder farmers receive inputs and advisory services from BAT with repayment for inputs deducted from the smallholder's harvest).

Until recently there has been a widespread belief in Uganda that the soils were very fertile and did not require fertilizer. Senior Ministry officials and many of the development agencies involved in agricultural sector development in Uganda now recognize that crop yields cannot be increased (or even sustained) without nutrient replenishment through the use of inorganic fertilizers.

Fertilizer Marketing System in Uganda

At present Uganda is totally dependent on imports for all inorganic fertilizers.[39] Eight to ten firms are

[39] Uganda possesses phosphate rock deposits that have been commercially mined in the past. The Busumbu deposit was in production from 1945 to 1963, and the Sukulu mine operated from 1963 to 1978. The rock was used to produce single superphosphate (0-18-0), which was used in Uganda as well as exported to Kenya and

presently engaged in fertilizer importation in Uganda (excluding direct imports by commercial farmers). The main firms importing fertilizer are Magric Ltd., Bolton Ltd., Bafumbira Farm Supply, Sukura Farm Supply Co., and El Shaddai. These firms carry a broad mix of products including agriculture input supplies. Import quantities are very small by international standards with quantities per transaction estimated at less than 100 mt to a maximum of 3,500 mt. The small size of import quantities, as well as physical limitations of the transport and storage systems, dictates that all fertilizer imports to Uganda be in bagged form. At present all imports are in 50-kg woven polypropylene (WPP) bags.

Table 7. KR2 Fertilizer Imports to Uganda, 1988-99

Year	Type	
	Urea/CAN	NPK (25:5:5)
	(mt)	
1988	-	1,080
1989	-	1,620
1990	200	-
1991	200	600
1992	-	1,830.6
1993	-	463.1
1994	-	1,124.16
1995	-	3,865.2
1996	-	-
1997	-	-
1998	-	-
1999[a]	3,500[b]	1,800

a. Preliminary estimates based on requests submitted by the MAAIF to JICA.
b. Includes 1,500 mt of CAN.
Source: Department of Crop Protection, MAAIF.

In addition to commercial imports, donor-supplied fertilizers have a significant impact in Uganda. Fertilizers imported under the Japan Kennedy Round 2 (KR2) program are sporadic (Table 7). The method for determining the quantities and fertilizer grades to be imported under KR2 is not transparent. However, once a determination is made on the quantity to be imported, Japan requests bids from Japanese suppliers. KR2-supplied fertilizer is provided to the recipient importer at a price equal to two-thirds of the f.o.b. source price (source was South Africa); that is equivalent to about 50% of the landed cost of

Tanzania. SSP is an excellent phosphate-bearing fertilizer. However, because of neglect of the factories during the 1970s and 1980s, the country is no longer producing fertilizer. At present, there is interest in development of the Busumbu deposit with a joint venture arrangement between a Ugandan firm and a Canadian firm. Marketing and prefeasibility studies have been completed and registration formalities have been finalized with the Ugandan Investment Authority. However, the planned startup activities have been deferred.

commercial imports. Although in absolute terms the quantity of KR2 fertilizers is not significant, relative to the size of the Uganda market it is significant.[40]

With regard to the fertilizer grades imported, despite the small size of the market, the product mix available in Uganda is rather extensive, reflecting the grade (nutrient)-specific requirements of the commercial crop growers, including the flower industry. For example, despite the early stage of market development and very low use levels, the following products have been available (albeit on a sporadic basis)—urea, AS, calcium ammonium nitrate (CAN), DAP, monoammonium phosphate (MAP), TSP, SSP, muriate of potash (MOP), 17-17-17, and a broad range of specialty grades such as 25-5-5+5S, 18-16-24+2MgO, and 10-10-20. Such a broad mix of product grades is rather more typical of a developed market.

The fertilizer marketing system in Uganda is in a very early stage of development and is slowly evolving. All firms engaged in the fertilizer business are private entities with varied experience in agri-input marketing. There are an estimated 8-10 importers (excluding imports by commercial growers), about 10-20 wholesalers, and 300-400 stockists.

Prior to 1999, almost all fertilizer importers basically functioned as brokers, importing fertilizer only after tendering for and being awarded a contract by major end-users. Imports were primarily being sourced from Europe and the Middle East. However, during the past 2-3 years several smaller Ugandan-owned firms (e.g., El Shaddai, Bafumbira Farm Supply, and Sukura Farm Supply Co.) have started operations and are sourcing supplies from the larger Kenya importers. This practice is having a very favorable impact on the Uganda market.

The stockist network is extremely limited in terms of geographic coverage. The vast majority of Uganda's farmers do not have convenient access to supplies. The small number of players in most markets is insufficient to stimulate intense competition for market share; hence, there is also varied competitive pressure to keep prices low. At the same time, high transport costs and uneconomic purchase quantities are key factors in the high prices paid for fertilizers by Ugandan farmers.

There is no direct subsidy on fertilizers in Uganda; albeit fertilizers received under grant aid (i.e., KR2) are sold at below import parity prices. Importers under the KR2 program are required to pay an amount equal to two-thirds of the f.o.b. source price of the fertilizers. In the case of commercial imports, prices are determined on a full cost basis. Import procurement is on the basis of competitive bids by suppliers. In spite of significant improvement in procurement practices (i.e., sourcing supply from Kenya importers), import costs remain extremely high by world standards. The high cost of transport from Mombasa to Uganda (i.e., about US $75/mt of bagged fertilizer) is a key reason for the high prices.

Fertilizer pricing in Uganda does not reflect strategies common in more advanced markets, where such strategies (e.g., quantity discounts, seasonal discounts to encourage off-season sales, etc.) are driven by competitive pressures and microeconomic factors. Rather, pricing is on a cost-plus basis and reflects both the high transaction cost and in general low levels of competition.

7.1.3. Fertilizer Marketing in Tanzania

[40] As the market develops and importers become more active in commercial importation, it will be important that the KR2 fertilizer be made available in a market-oriented manner.

Consumption Trends in Tanzania

The evolution of the fertilizer market in Tanzania includes three distinct phases: Phase I (1970-83, planned economy phase); Phase II (1984-93, reform/transitional phase); Phase III (1994-present, competitive market phase). The developments that occurred during each phase substantially influenced the irregular trend in Tanzania fertilizer use. With a significant awareness of the importance of fertilizer use in improving crop yields, fertilizer use was strongly encouraged and heavily subsidized during Phase I. Aggregate fertilizer consumption more than doubled during the first 8 years of this phase, from 16,000 mt of nutrients in 1972 to 35,000 mt of nutrients in 1980 (Table 8). The NPK ratio was 1:0.5:0.37 in 1972; reflecting the predominance of fertilizer use on estates. In 1980 the NPK ratio was 1:0.43:0.15, reflecting the increased use by smallholder and the emphasis on N and NP fertilizers (Figure 9). During the final 3 years of Phase I, fertilizer use declined, totaling only 22,900 mt of nutrients in 1983. This downturn was largely related to reduced supply availability linked to production problems at the Tanzania Fertilizer Company (TFC) factory.

Fertilizer use during the initial years of Phase II (1984-93) accelerated quickly with aggregate use estimated at 51,200 mt in 1990; that is a 123% increase over the 1983 use level. During this period, donor-financed fertilizer accounted for almost all (100% in 1985-87 and 1989) of the fertilizer imports by Tanzania. During the final 3 years of Phase II, fertilizer use in Tanzania declined sharply to only 36,300 mt of nutrients in 1993. During this same period, fertilizer production in Tanzania ceased, donor-supplied imports declined and farm-level prices increased substantially.

During the present phase (1994-present), fertilizer use has stagnated and in 1998 was estimated at only 27,800 mt of nutrients; this is 11% below the use level recorded in 1974. The present NPK ratio is 1:0.32:0.13. The continued weakness in the fertilizer market can be linked to (1) the disruption in the fertilizer marketing system, (2) high fertilizer prices, (3) weak crop markets (particularly coffee), and (4) nonavailability of credit.

Fertilizer Marketing System in Tanzania

The fertilizer marketing system in Tanzania experienced dramatic change during the past three decades. In Phase I, TFC enjoyed a near monopoly in production, procurement, and marketing.[41] TFC maintained distribution depots in the regional headquarters and appointed its agents to distribute fertilizers. Cooperative Unions (CUs) and primary societies acted as agents for TFC. TFC distributed fertilizers at heavily subsidized pan-territorial prices to CUs, which in turn sold fertilizers to farmers and primary societies on credit and bought crop produce at the harvest time. During Phase II fertilizer imports (largely based on grants) continued to increase and the GOT attempted to reduce the price subsidy. However, the marketing system continued to be administered by the government. In Phase III, the marketing system changed drastically. The GOT effectively ceased fertilizer importation and marketing activities.

[41] During the 1970-78 period, Tanzania Rural Development Corporation had the monopoly to distribute imported fertilizers.

Table 8. Fertilizer Nutrient Consumption in Tanzania, 1963-1998

Year	N	P_2O_5	K_2O	Total
	(mt nutrients)			
1962	1,149	758	473	2,380
1963	1,500	800	800	3,100
1964	1,500	800	1,600	3,900
1965	4,000	1,000	2,000	7,000
1966	5,000	1,300	2,500	8,800
1967	4,000	1,500	3,200	8,700
1968	4,000	2,000	3,000	9,000
1969	5,000	3,500	2,500	11,000
1970	8,000	4,000	3,000	15,000
1971	10,700	3,500	3,200	17,400
1972	8,611	4,266	3,151	16,028
1973	11,133	5,800	3,004	19,937
1974	13,944	11,655	5,545	31,144
1975	14,891	11,300	3,479	29,670
1976	13,337	11,020	6,364	30,721
1977	16,031	9,115	4,600	29,746
1978	12,900	10,400	6,000	29,300
1979	23,000	4,500	2,500	30,000
1980	22,800	9,400	3,300	35,500
1981	17,500	8,500	3,100	29,100
1982	15,771	4,797	3,155	23,723
1983	15,463	5,200	2,271	22,934
1984	23,500	9,000	2,200	34,700
1985	24,704	10,973	3,250	38,927
1986	29,500	12,100	3,800	45,400
1987	32,122	12,547	3,363	48,032
1988	26,956	11,107	3,036	41,099
1989	28,700	16,300	4,000	49,000
1990	36,678	11,694	2,877	51,249
1991	33,644	11,318	4,717	49,679
1992	33,078	10,000	4,776	47,854
1993	26,300	6,800	3,200	36,300
1994	25,400	6,900	3,600	35,900
1995	15,000	7,000	5,000	27,000
1996	20,228	7,000	4,039	31,267
1997	21,909	9,503	6,737	38,149
1998	19,324	5,951	2,551	27,826

Source: FAO.

Prior to the early 1990s, essentially no private-sector firms engaged in fertilizer importation. The main reason for the private-sector reluctance to import was that the GOT continued to provide subsidized fertilizer (25% subsidy) to TFC. When the GOT announced in 1993/94 that private-sector firms would also receive a like subsidy, the private sector responded by importing 227,000 mt (product tons) of fertilizers. That was more than double the use in the previous year. To the misfortune of the private

sector, the high level of imports exceeded the GOT's budget for fertilizer subsidies and the majority of the importers received no benefit of the "promised subsidy." While this "event" did finally break the monopoly of TFC, it also resulted in many of the importers (particularly those inexperienced in the fertilizer business) being bankrupted. A limited number of private importers developed their own distribution networks, albeit most distributors opened depots at regional headquarters (e.g., in Iringa, Arusha, and Dar-es-Salaam). There are few retail shops or appointed agents/dealers in the villages; most have to go to the regional headquarters, either individually or as a group, to obtain input supplies. Today, recent developments have substantially reduced the size of the fertilizer market and the fertilizer marketing system can best be described as fragmented and dysfunctional.

Fertilizer subsidies played a key role in stimulating fertilizer use in the 1970s and 1980s. During the mid-1980s efforts were made to reduce the subsidy. As a result, fertilizer prices in Tanzania increased dramatically during 1986-96 (Figures 10 and 11). The increase was mainly due to the removal of subsidies and exchange rate devaluation. Real fertilizer prices (kg of maize/kg N through urea) show a declining trend until 1988/89. Thereafter, both nominal and real fertilizer prices show an increasing trend. During the 1988-90 period farmers were paying 2.0-2.4 kg of maize per kg of N from urea, whereas during the 1992-95 period farmers were paying 8-13 kg of maize for 1 kg of N.[42] In nominal terms, prices increased over twentyfold—from TSh 11,900/mt (TSh 595/50-kg bag) in 1990 to TSh 240,000/mt (Tsh 12,000/50-kg bag) in 1996; the real price increased over sixfold. These severalfold increases in fertilizer prices have several implications. First, fertilizer use became very costly for farmers and therefore there was a decrease in use. Second, fertilizer prices increased by a much higher margin than maize prices and therefore affected the profitability of fertilizer use. Third, a twentyfold increase in nominal fertilizer prices increased demand for credit resources while the institutional infrastructures to supply loanable funds in rural areas could not be developed. Thus, both profitability of fertilizer use and availability of funds to purchase fertilizers were seriously affected. Because maize prices were not able to keep pace with increases in fertilizer prices, the incentive to use fertilizer was seriously eroded.

Because of decreases in international fertilizer prices during the mid to late 1990s, fertilizer prices in Tanzania decreased after 1996 (Figure 12). The nominal price of urea decreased from TSh 240,000/mt in 1996 to TSh 190,000/mt in 1999. The real price dropped from 13 kg of maize to 11 kg of maize per kg of N. Even with this decrease, fertilizer prices remain high in Tanzania in comparison to the global market and other developing countries. In the world market in 1998, 1 kg of N through urea cost 2.6 kg of maize and 1 kg of N and P_2O_5 through DAP cost 3.1 kg of maize in contrast to 9.1 kg and 10.4 kg, respectively, in Iringa (Table 9). Clearly such high cost is not conducive to the growth in fertilizer use.

[42] These prices will be higher if the price of N was calculated through AS or CAN.

Table 9. Tanzania: Kilograms of Maize Required to Purchase 1 kg of Nutrient Through Different Products, 1999

	July/August		March/April	
	Iringa	Arusha	Iringa	Arusha
A. Tanzania				
Urea	9.1	9.0	2.0	2.0
AS	17.0	17.9	3.8	4.0
CAN	16.4		1.8	
DAP	10.4		2.3	
B. International Market, 1998				
Urea	2.6			
DAP	3.1			

Source: Based on data collected during the field visits.

Not only do the Tanzanian farmers pay high cost relative to their counterparts in the world market, they pay high prices for nutrients by using low-analysis products. For example, in Iringa, 1 kg of N costs 9 kg of maize through urea and 17 kg of maize through AS. Because the nominal price of AS is slightly lower than that of urea, farmers often purchase the cheaper bag of fertilizer without realizing the nutrient content of the product involved. This is a result of poor knowledge and extension support for educating farmers. The real cost of fertilizers drops significantly from July/August to March/April because maize prices are significantly higher in the later months just before the planting season (Table 9). Educating farmers about this price spread and creating facilities for empowering them to benefit from higher maize prices in the later half of the cropping year can help in reducing costs of fertilizers.

7.2. Government Involvement in Fertilizer Marketing and the Liberalization Process

Government involvement in the fertilizer sector of developing countries throughout the world has (historically) been very common. This was the case in Kenya during the 1970s and 1980s and in Tanzania until the early 1990s. The nature of government intervention included price controls (direct subsidies in Tanzania and price setting in Kenya); import controls (direct imports by the GOK and GOT, and allocation of import allotments in Kenya); fertilizer marketing (direct marketing through nominated parastatals in Kenya and Tanzania); direct involvement in fertilizer production (Tanzania) and direct involvement in extension, market information, and demand forecasting (GOK) as well as substantial participation in "noncommercial" activities such as research and development. Government involvement was rationalized on the basis of (1) the key role of fertilizer in agricultural production and thus food security and (2) the high cost involved in fertilizer importation and marketing, and belief that few private firms possess the financial resources to effect large "efficient" input procurements. The matter of dealing with donor-supplied fertilizers was also an issue that necessitated government involvement. In the case of Kenya, a general concern (in the early 1970s) that the private sector was attempting to manipulate the domestic market and exploit farmers was a key factor in the GOK's intervention. The recent history of the declining role of government and the increasing role of the private sector in each of the three countries is indicated in Table 10.

As indicated, the role of government in the fertilizer sector in each of the three countries has subsided. However, the market liberalization process (policy measures and impact on fertilizer use) was varied by country as follows:

Table 10. Role of Government and Private Sector in Fertilizer Markets in Kenya, Tanzania, and Uganda, 1970-2000

Function	Country	1970s	1980s	1990s	2000
Importation[a]	Kenya	G/P	G/P	P/G	P
	Tanzania	G	G	G/P	P
	Uganda	P/Nil	P/Nil	P/Nil	P
Distribution	Kenya	G/P	G/P	P/G	P
	Tanzania	G	G	G/P	P
	Uganda	P/Nil	P/Nil	P/Nil	P
Pricing	Kenya	G/P	G/P	P	P
	Tanzania	G	G	G/P	P
	Uganda	P	P	P	P
Promotion	Kenya	G/P	G/P	G/P	G/P
	Tanzania	G	G	G/P	G/P
	Uganda	G/Nil	G/Nil	G/Nil	G/P
Product Determination	Kenya	G/P	G/P	P	P
	Tanzania	G	G	G/P	P
	Uganda	P/Nil	P/Nil	P/Nil	P
Market Research (Demand forecasts)	Kenya	G	G	G/P	P/G
	Tanzania	G	G	G/P	P/G
	Uganda	P/Nil	P/Nil	P/G/Nil	P/G/Nil

G = government.
P = private sector.
Nil = insignificant.
a. In all three countries donor (Japan)-supplied fertilizer is being provided on a somewhat sporadic basis. Hence the respective Governments of Kenya, Tanzania, and Uganda are involved in discussion with donors and subsequently the domestic distribution.

7.2.1. Kenya

Market reform was gradual, over a 10-year period. Reforms to liberalize prices, imports, and domestic marketing were encouraged by donors who supplied (1) grant fertilizer on the basis of conditionalities to implement policy reform and (2) technical consultants to provide both policy and technical guidance to the GOK. The overall transition/reform process occurred without severe disruption to the market. It is noteworthy that while the GOK did control prices throughout the 1970s and 1980s, farm-level prices were determined by a somewhat "market-oriented," cost-plus pricing model. While the government did subsidize the parastatals (KNTC and KGGCU), there was no direct price subsidy to farmers. Hence, when the fertilizer market and prices were fully decontrolled, there was not a "sudden" escalation in farm-level

prices. Another key feature in Kenya is the substantial role of commercial crop production, accounting for 60% of the total fertilizer market, a major stabilizing factor in the Kenya fertilizer market.

7.2.2. Tanzania

Fertilizer market reform was also gradual in Tanzania, occurring over an 11-year period. Donor fertilizer supply was an important contribution to total supply in the 1980s, but conditionalities regarding policy reform and the provision of technical assistance (policy and technical guidance) were much less notable in the Tanzania reform process. The withdrawal of the GOT from fertilizer supply and marketing was not complemented with a phasing in of the private sector. The GOT's handling of the subsidy issue was not consistent, and when the government announced it would apply to private-sector imports, the private sector responded with excess imports. This led to a serious disruption in the structure and stability of the marketing system and reduced demand in the early 1990s. The economic reforms of the late 1980s and early 1990s resulted in the collapse of the estate farm sector, a key segment of the fertilizer market. Hence, unlike Kenya, Tanzania did not have the benefit of this stabilizing sector in the fertilizer market.

7.2.3. Uganda

Unlike in Kenya and Tanzania, there was been (at least up until the late 1990s) little government emphasis on improving fertilizer use in Uganda. The fertilizer market was (and is) extremely small. Imports are handled by a few private firms. The fertilizer market reform process actually occurred as a part of Uganda's general reform process, not as a specifically targeted initiative. The Government of Japan has provided a small quantity of fertilizer (Table 7) as grant aid; however, this has been provided without ties to market reform initiatives. In summary, the Uganda fertilizer market is in the introductory stage of development (following essentially two decades of political disruptions and little use of fertilizers) and, as such, did not experience disruptions that may typically be associated with reform measures. However, the fertilizer marketing system remains a very limited physical distribution system with sales outlets not widely (geographically) dispersed. The fragmented nature of the marketing system with a very limited stockist network restricts smallholder access to fertilizers.

Fertilizer market reform in Kenya and Tanzania (and to some extent Uganda) has allowed the respective governments to reallocate resources to other development issues. The private sector in each of the three countries is now responsible for importation and domestic marketing (e.g., transport, storage, sales, etc.). Kenya has benefited from improved efficiency in imports and domestic marketing. Improvements are also being made in the Tanzania market. And, during the past year, the fertilizer market in Uganda has improved substantially in terms of both supply availability and competitive pricing. However, the reform process failed to adequately address three key issues that ideally should have been addressed in a concurrent manner. They are:

- **Fertilizer Market Development**—Emphasis was not given to strengthening the private-sector capacity to provide (as a complement to the Ministry of Agriculture [MOA] Agricultural Extension Service) advisory services to farmers. As the final link in the marketing chain and the point of contact with farmers, stockists are key to providing advisory services to farmers on proper input use. Today, few stockists in Kenya, Tanzania, and Uganda are able to provide correct information to farmers on import use recommendations and the most economical source of plant nutrients (i.e., fertilizer product which contains lowest cost per unit of nutrient).

- **Credit System Development**—Fertilizer marketing is capital intensive, and at each level in the marketing chain credit is required to purchase and hold stocks. The availability of working capital credit (or lack thereof) in Tanzania is a prime reason for low stock levels at the stockist level. This is also a problem in Kenya albeit to some extent wholesalers do provide short-term credit (e.g., postdated demand draft) to retailers/stockists. In Uganda, development projects (USAID and SG2000) are addressing this issue by providing partial credit directly to stockists. The supply line in each of the three countries is long and in order to improve marketing system efficiency, suitable credit facilities are essential to enable proper import management.

- **Fertilizer Market Information**—Timely and accurate information on markets is essential to market transparency. For many years this has been a serious void in all three countries and an issue that must be addressed to improve decisionmaking by private firms. In "markets in transition," it is also essential to keep policymakers apprised with "real facts" on fertilizer market conditions (e.g., prices, supply availability, import arrivals, etc.). A market-oriented information system is necessary to improve market efficiency and to allow the respective governments to assess market conditions.

7.3. Lessons Learned

In each of the three countries (but particularly Kenya and Tanzania), a key assumption, by donors as well as the respective government policymakers, was that market liberalization would stimulate private-sector investment and competition for market share would provide sufficient incentive for market development and promotional programs to spur increased fertilizer sales (and thus use by smallholders). Empirical evidence substantiates that market liberalization does not automatically stimulate private-sector investment. Cost and risk factors (including skepticism with regard to government consistency on policy reform issues), weak technical knowledge, lack of business acumen (particularly regarding import procurement), lack of appreciation for the long-term benefits that accrue from market development, and a relatively short-sighted approach to business operations are key reasons for reluctance by the private sector to invest in the fertilizer sector. A key lesson learned is that it is essential to continuously address each of these constraints to private-sector development. A second lesson learned is that credit availability (early in the reform/liberalization process) is essential to enable the private sector to engage in fertilizer marketing. A third lesson learned is that marketing system operational efficiency is dependent upon improved market transparency—this is best exemplified by the recent price reductions realized in Uganda.

7.4. Opportunities for Regional Collaboration

Despite their geographic close proximity and similar agro-ecological conditions, the fertilizer markets in Kenya, Tanzania, and Uganda (mainly due to political differences) have evolved with essentially minimal interrelationships. Kenya and Tanzania have long recognized the role of improved fertilizer use in agriculture sector performance. Only in recent years has the Government of Uganda emphasized the importance of improving the use of inorganic fertilizers. Kenya has for much of the past two decades embraced a market-economy approach to fertilizer market development; Tanzania has adopted this approach for the past 15-20 years and Uganda the past 6-8 years. Uganda experienced extreme political disruption during the 1970s and 1980s, and the use of fertilizer was discontinued. Due to a number of circumstances (e.g., donor involvement, national emphasis on fertilizer sector development, political

independence, etc.), there has been no real effort to capitalize on the potential benefits of regional cooperation that can and will likely result in improved supply availability and lower farm-level fertilizer pricing in each of the three countries.

The benefit from improved regional cooperation can be quite significant in three areas as follows:

- Developing regional business linkages.
- Developing regional market information services.
- Developing a coordinated policy framework.

7.4.1. Regional Business Linkages

The fertilizer market in Kenya (and to some extent in Tanzania) is of sufficient size to allow economies of scale in fertilizer procurement from suppliers of the international market. The Kenya market is also highly competitive. Importers/wholesalers are aggressively seeking to expand sales. At the same time, importers in Tanzania and Uganda have (until recently) imported fertilizers direct from international suppliers. In the case of Tanzania, import quantities are of sufficient size to generate price efficiencies. However, this is not the case in Uganda and was a key factor that resulted in extremely high farm-level prices in Uganda in 1998. To briefly summarize the situation in Uganda, in 1998 IFDC conducted an assessment of the fertilizer market in Uganda.[43] At that time fertilizer prices (in Uganda) were extremely high by global standards. Prices of two of the most commonly used products—urea and DAP—were US $525/mt and US $625/mt, respectively.

In 1998 import quantities by individual firms ranged from only 300 mt to 2,700 mt of product. Clearly, the import quantities were too small to generate "economies of scale" needed to achieve attractive international procurement costs and economic freight rates. Imports were mainly sourced from Europe, South Africa, Middle East, and Mauritius. The import practices in Uganda during 1998 were not conducive to achieving the lowest possible import costs. *IFDC recommended that sourcing of supplies from Kenya could substantially reduce import costs and thus farm-level fertilizer prices.*

In December 2000, IFDC conducted a "follow-up" pricing study in Uganda. It was observed that fertilizer prices (in Uganda shillings) were on par with those levels observed in late 1998. Hence, in spite of a 50% depreciation of the Uganda shilling (against the U.S. dollar),[44] farm-level fertilizer prices declined significantly in U.S. dollar terms. In late 1998, urea and DAP prices (stockist level) were US $26.25 and US $31.25 per 50-kg bag, respectively. In late 2000, average urea and DAP retail prices were US $16.70 and US $20.55 per 50-kg bag, respectively.[45]

It is an anomaly that stockist-level prices substantially declined despite the weakening of the shilling against the dollar. This phenomenon can best be explained by four key developments: (1) an increase in the number of emerging importers procuring supplies from Kenya (i.e., Uganda is benefiting from the economies of scale realized by Kenya importers); (2) increased competition among importers and, to

[43] The Fertilizer Market in Uganda: An Assessment and Strategy for Development," September 1999.

[44] November 1998, US $1 = ugx 1,200; December 2000, US $1 = ugx 1,800.

[45] Average stockist-level prices.

some extent, at the stockist level; (3) changes in international market prices; and (4) increased supply availability, relative to demand in Kenya (particularly in the case of DAP).

An examination of the costs of importation based upon procurement from the larger Kenyan importers is instructive and provides insight to the actual benefits accruing to Uganda and the potential efficiencies available to Rwanda firms. It is estimated that the cost for a Uganda firm to import urea from Kenya (10-mt lorry) in December 2000 would be in the range of US $270-$285/mt or US $13.50-$14.25 per 50-kg bag. In the case of DAP, imported from Kenya (10-mt lorry) in December 2000, the estimated cost is in the range of US $324-$343/mt or US $16.20-$17.25 per 50-kg bag. Figure 13 illustrates the costing of imports at various points in the marketing system in Kenya and Uganda.

7.4.2. Developing Regional Market Information Services

Improved market transparency is key to improved market efficiency. Timely information on fertilizer market prices in each of the East Africa countries as well as information on international market prices, freight rates, and import arrivals is essential for decision making at all levels in the marketing system. Such information is necessary to improve private-sector awareness of the potential gains from regional business linkages. Moreover, policymakers and donors benefit from improved market transparency by better understanding the factors that influence such developments as price increases (which increasingly will be influenced in Kenya, Tanzania, and Uganda by global market prices) and supply shortfalls when they do occur.

7.4.3. Coordination of Policies on Fertilizer Subsector

In order to achieve improved regional fertilizer sector performance, selected policies should be in harmony. This would include government policies on:

1. **Fertilizer Prices**—Borders are porous and when subsidies exist in one country and not another, illegal border trade usually occurs. Consistency in pricing policies will help to promote market efficiency.

2. **Regulatory System**—It is important to promote "legal" border trade, and harmony in regulatory policies based on "truth in labeling" is key to quality control of fertilizer products.

3. **Donor Aid**—Donor supplies, particularly agri-inputs provided under KR2, should be integrated in the market in a market-oriented fashion.

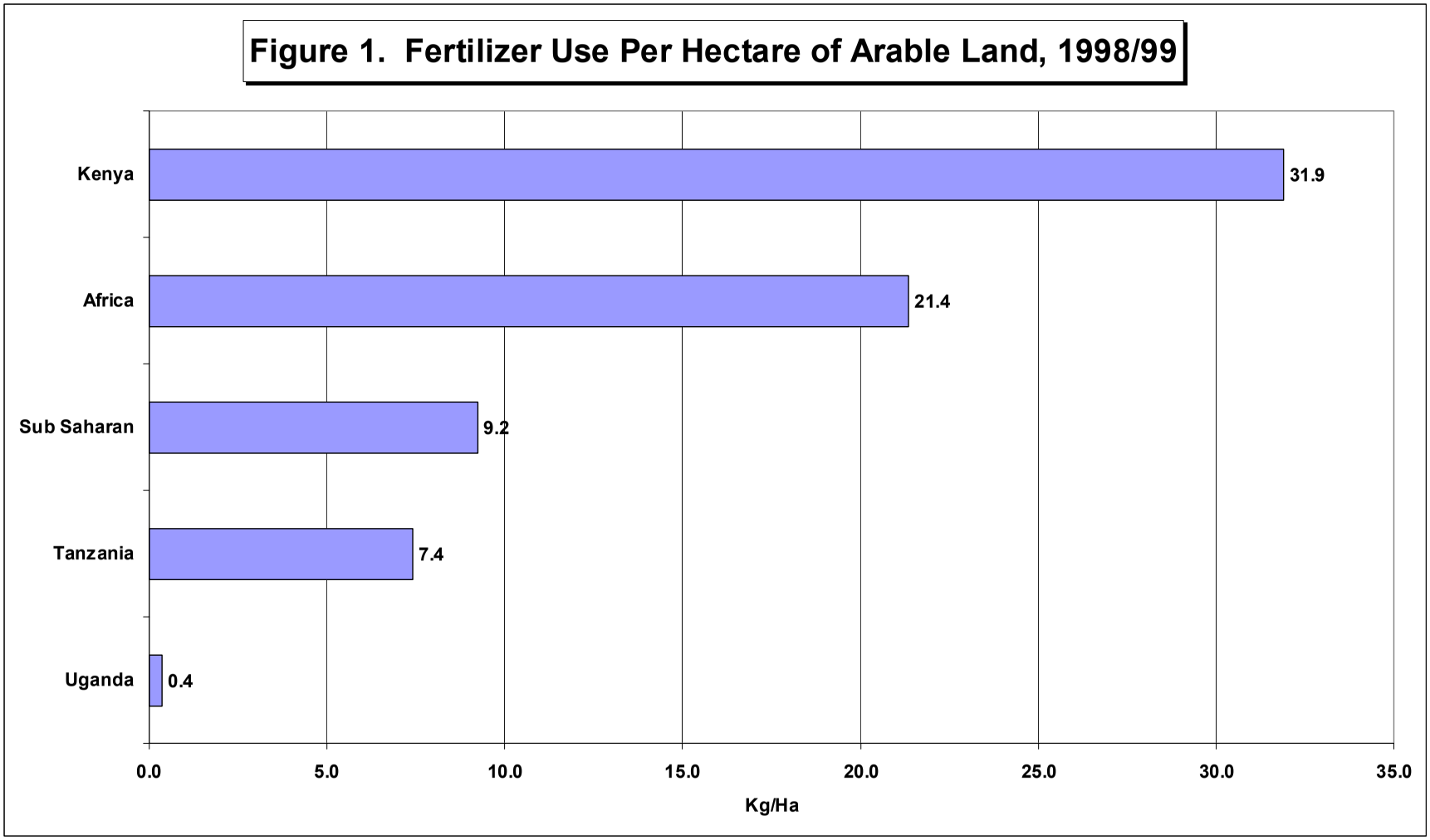


Figure 1. Fertilizer Use Per Hectare of Arable Land, 1998/99
Kenya
Africa
Sub Saharan
Tanzania
Uganda
31.9
21.4
9.2
7.4
0.4
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
Kg/Ha

Figure 2. Kenya, Rwanda, Tanzania, Uganda—Nutrient Depletion

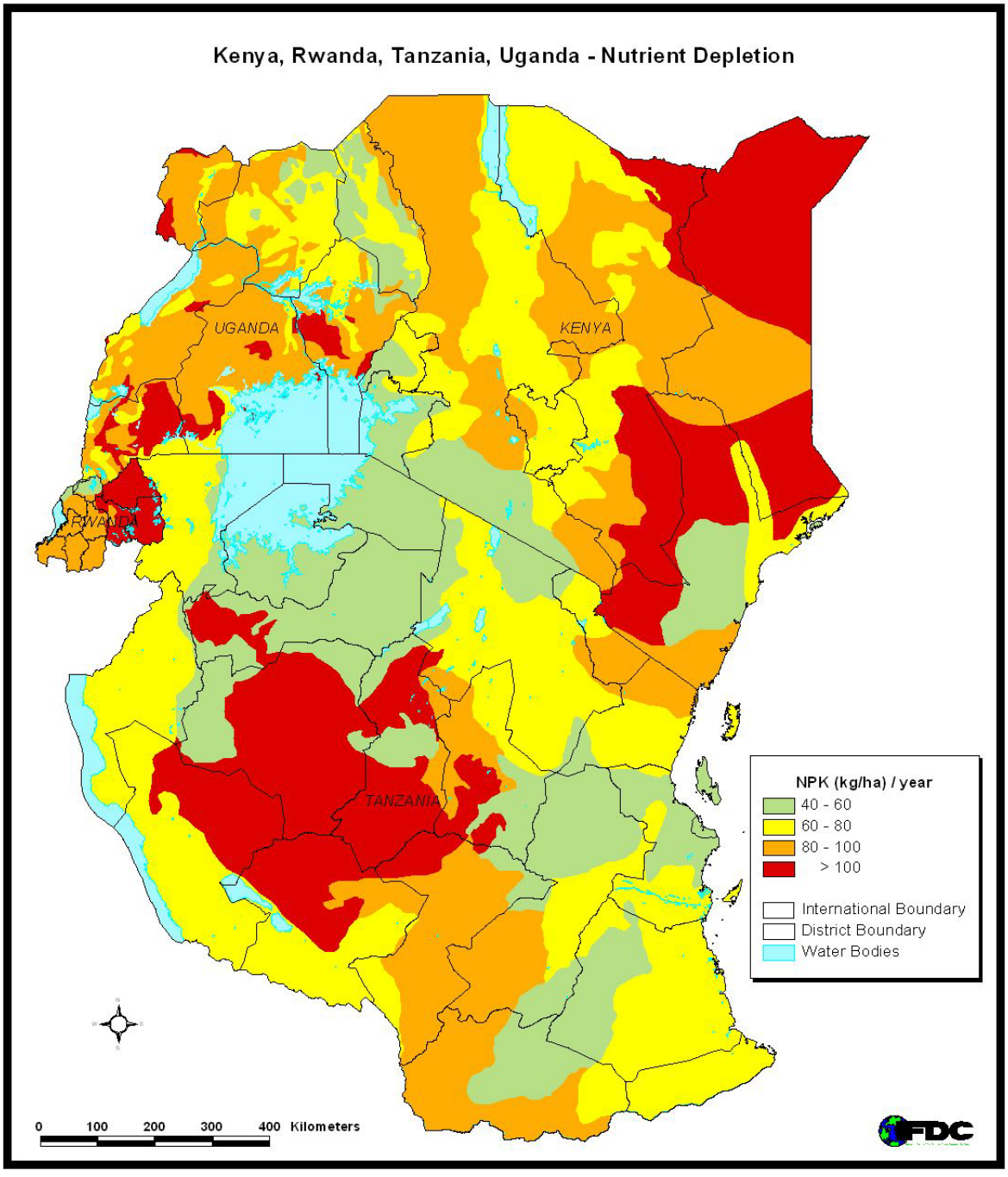
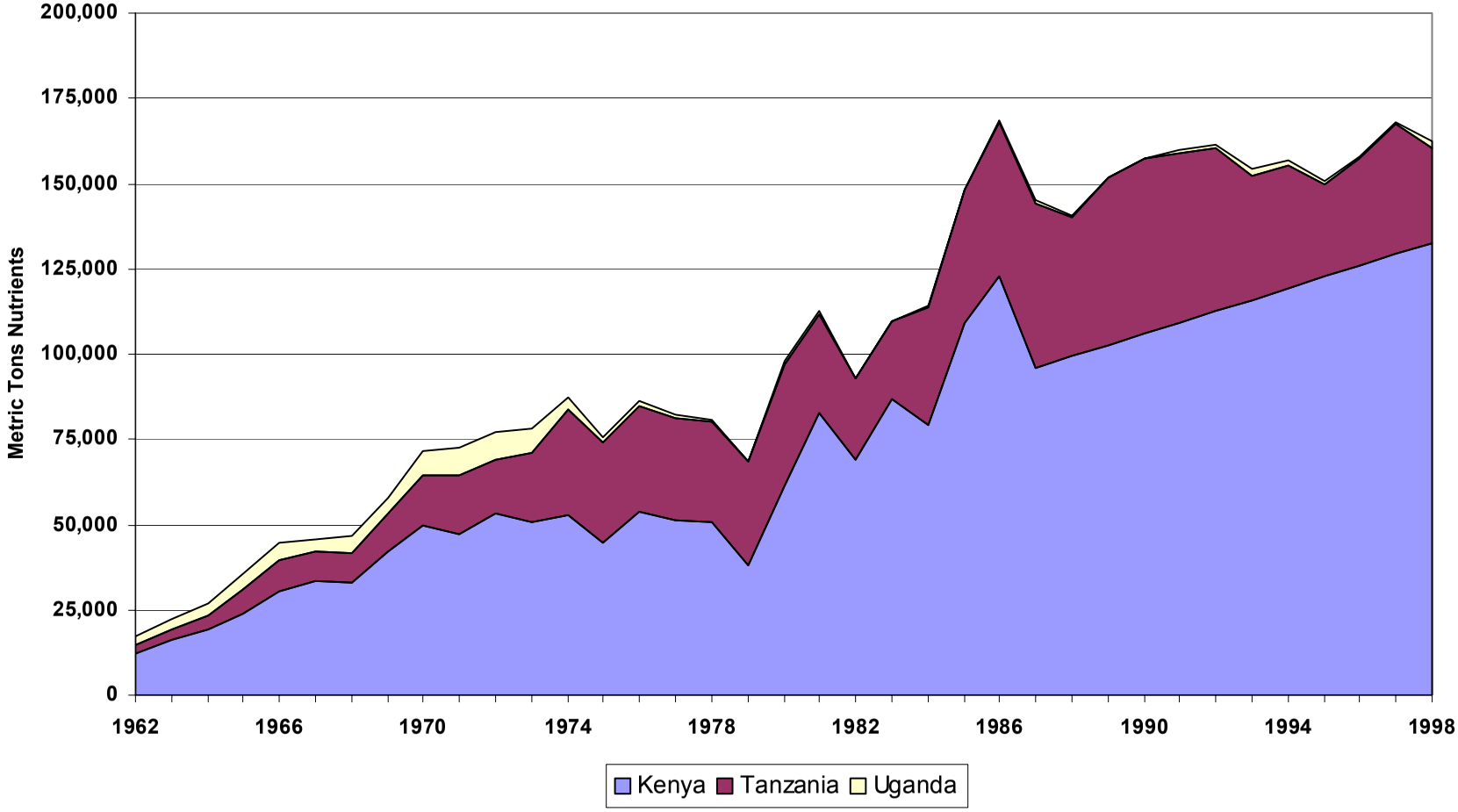
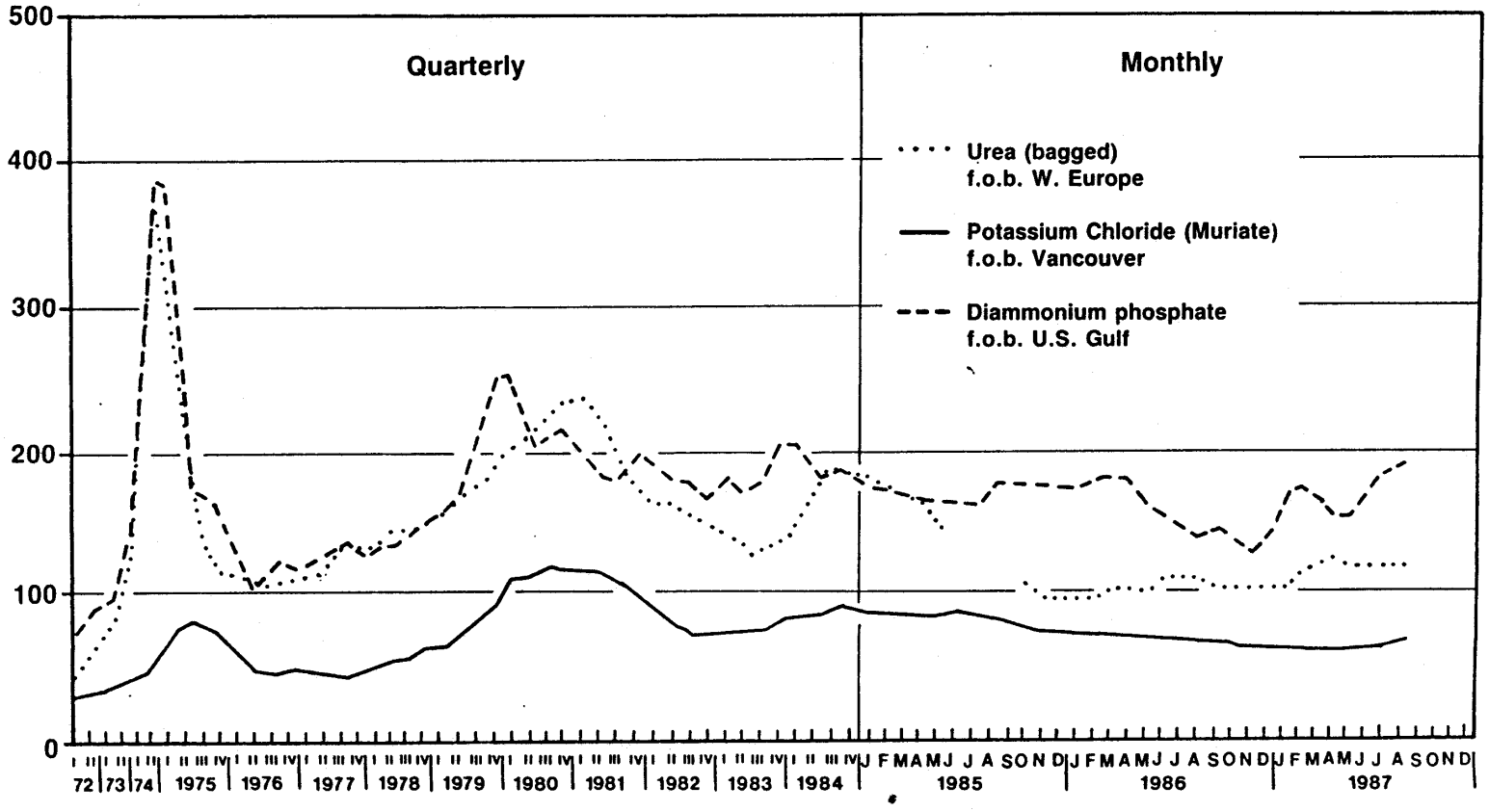


Figure 3. Fertilizer Nutrient Consumption, 1962 to Present—Kenya, Tanzania, and Uganda





Source: World Bank, 1965 to October 1975. November 1975 to August 1987 based on information obtained from various sources.

Figure 4. Export Price Trends for Some Major Fertilizer Materials (US Dollars per metric ton of product)

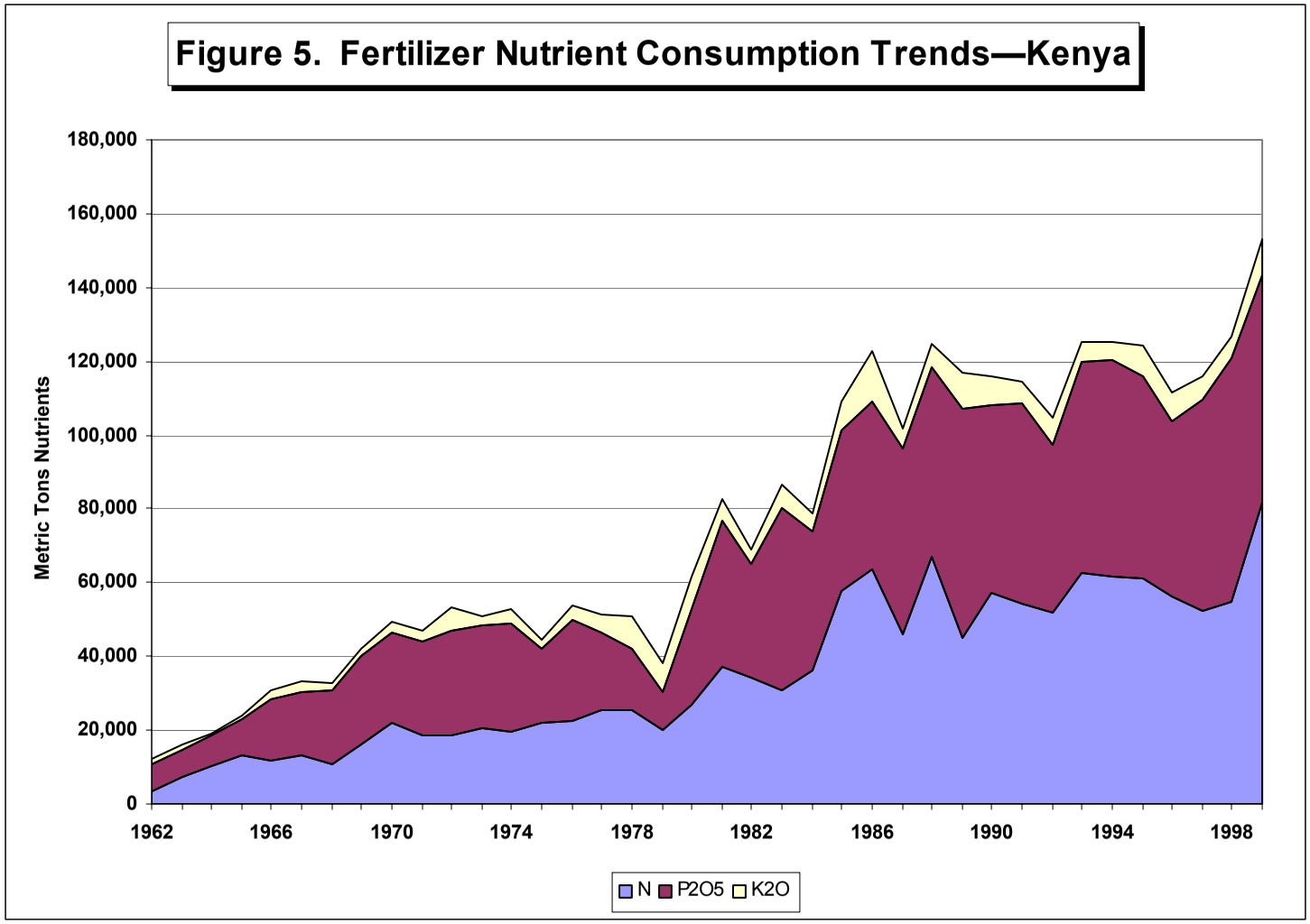


Figure 5. Fertilizer Nutrient Consumption Trends—Kenya
Metric Tons Nutrients
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
N
P2O5
K2O

Figure 6. Policy Changes and Development Initiatives Involving the Kenya Fertilizer Sector

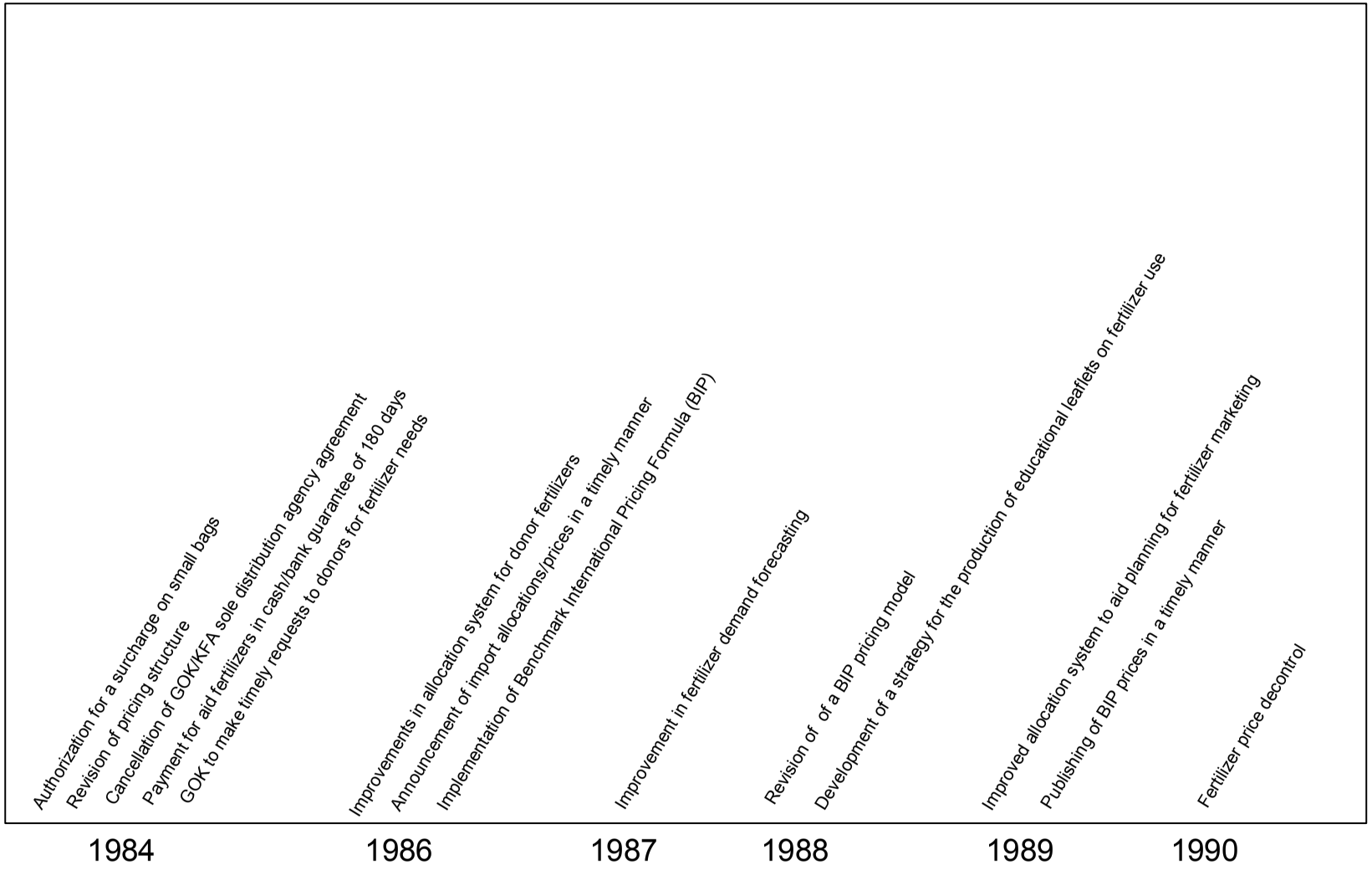
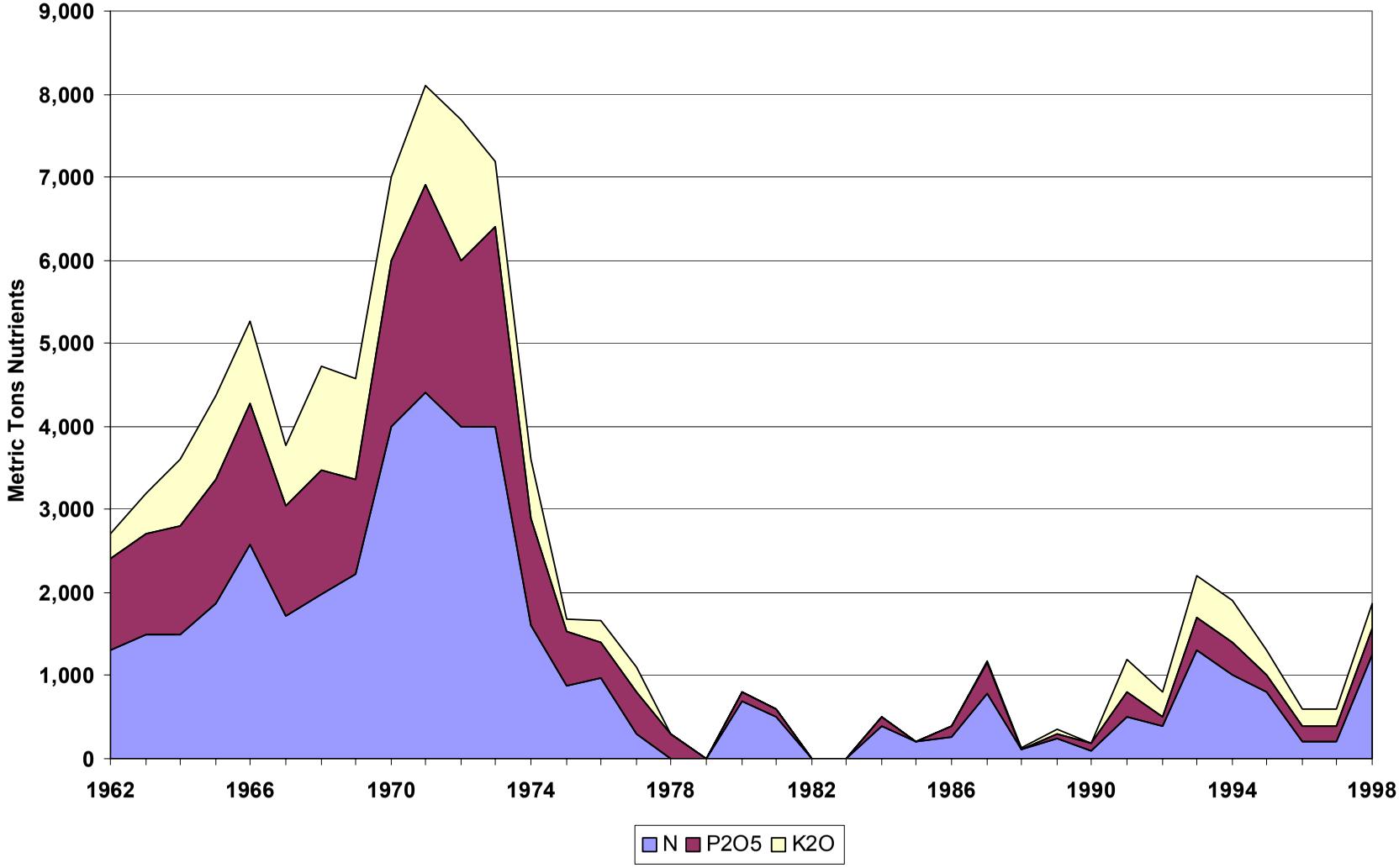


Figure 7. Retail Fertilizer Pricing Model

Ref.		%	KSh	Operation
FOR Mombasa Cost				
1	Benchmark price (BP)			BP (established by MOA)
2	Insurance	1.65		As % of BP
3	CBK	1.00		As % of BP
4	Letter of credit	0.50		As % of BP
5	Bank charge	0.50		As % of BP
6	Payment charge	0.50		As % of BP
7	C & F finance costs	3.75		As % of BP
8	Wharfage	1.50		As % of BP
9	Shore handling		35	Per mt
10	Clearing and forwarding	1.00		As % of BP
11	Transit loss	1.00		As % of BP
12	Miscellaneous charge		10	Per mt
13				Add all the above costs
14	Financing 2 to 11			% of above addition (Ref. 13)
15	**FOR Mombasa Cost**			Add all the above costs
Cost at Center				
16	FOR Mombasa Cost			Given by Ref. 15
17	Transport		X	Per mt—varies per market center
18	Handling		24	Per mt
19	Storage		12	Per mt
20	**Cost at Center**			Add all the above costs (variable)
Importer				
21	Cost to importer			Given by Ref. 20
22	Importer margin	5.00		As % of Ref. 21
23	**Importer sell price**			Add all the above costs (variable)
Distributor				
24	Distributor purchase price			Given by Ref. 23
25	Handling		24.00	Per mt
26	Storage—1 month for 100%		12.00	Per mt
27	Finance—1 month for 100%	1.25		As % of costs to this stage
28	Storage—1 month for 50%		6.00	Per mt
29	Finance—1 month for 50%	0.63		As % of costs to this stage
30	Storage—1 month for 20%		2.40	Per mt
31	Finance—1 month for 20%	0.25		As % of costs to this stage
32	Cost to distributor			Add all the above costs
33	Distributor margin	5.00		As % of Ref. 32
34	**Distributor sell price**			Add all the above costs (variable)
Retailer				
35	Retail purchase price			Given by Ref. 34
36	Retail margin			As % of Ref. 35
37	**Retail Price**			Add all the above costs

Source: Report on Inputs Unit and Fertilizer Pricing in Kenya, September 1989, USAID

Figure 8. Nutrient Consumption In Uganda



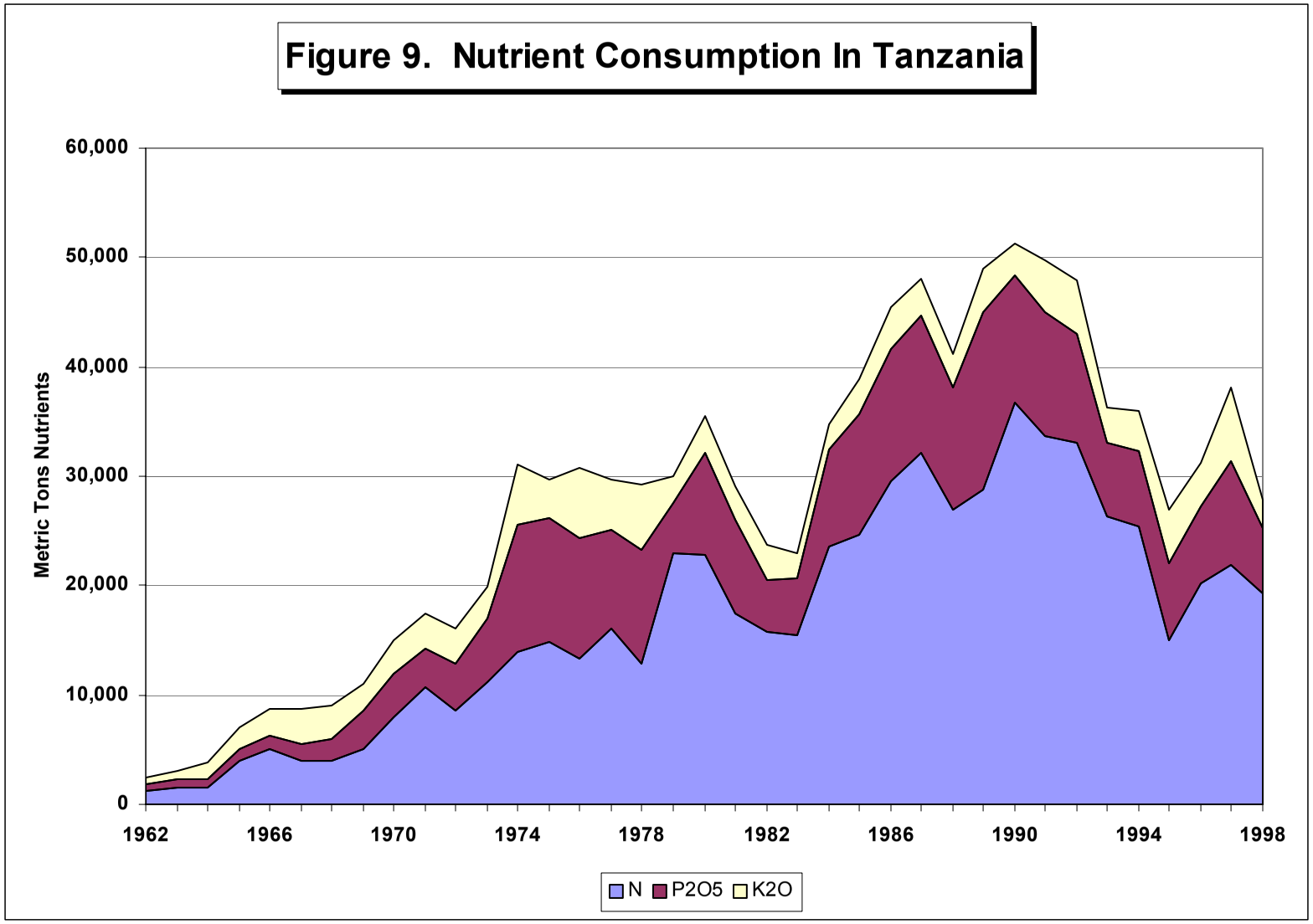
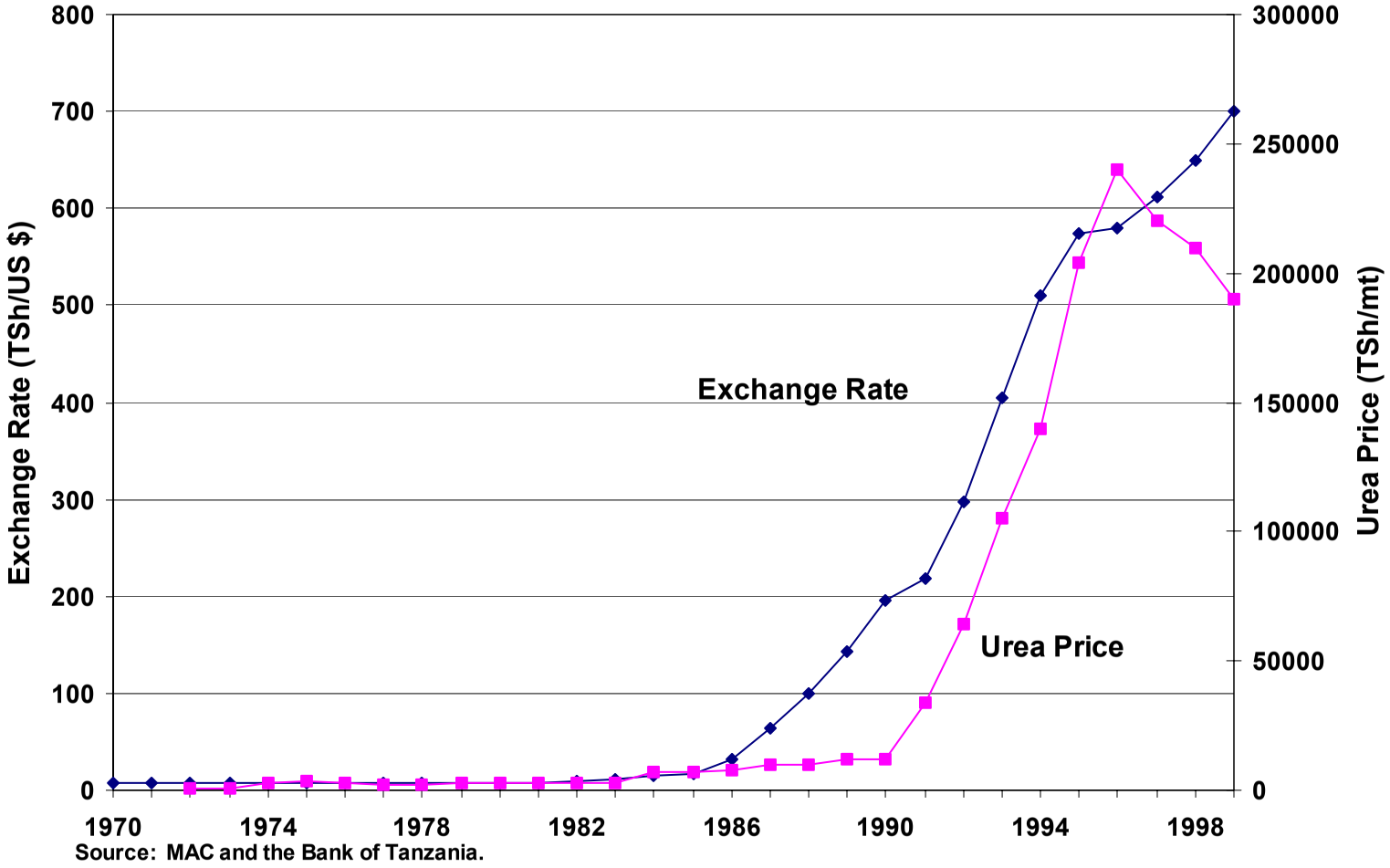


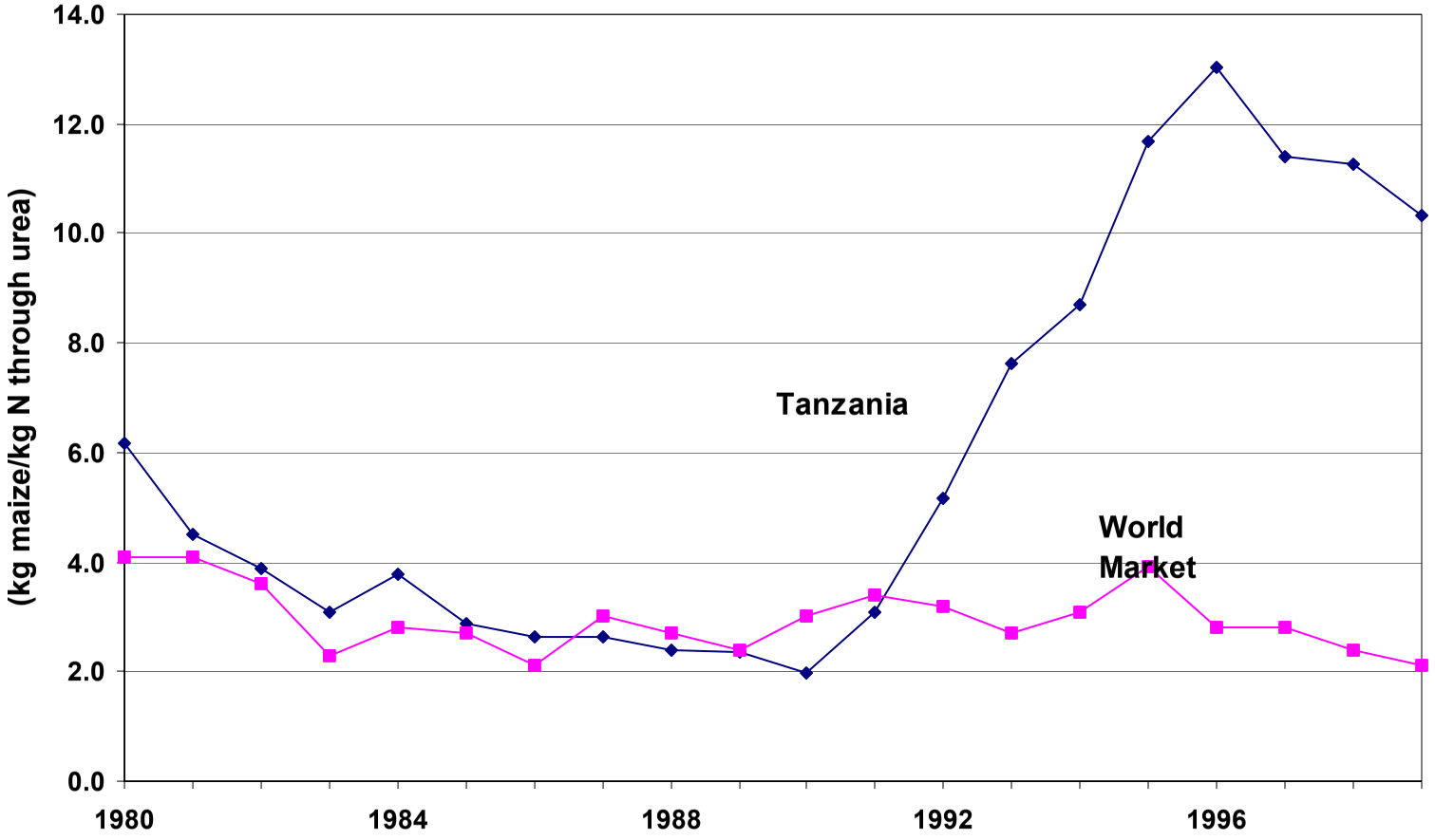
Figure 9. Nutrient Consumption In Tanzania
Metric Tons Nutrients
60,000
50,000
40,000
30,000
20,000
10,000
0
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
N
P2O5
K2O

Figure 10. Tanzania: Urea Price and Exchange Rate, 1972-99



Source: MAC and the Bank of Tanzania.

Figure 11. Real Price of Nitrogen in Tanzania and the World Market, 1980-99



Source: MAC (Tanzania) and World Bank (World Market).

Figure 12. Urea and DAP Prices

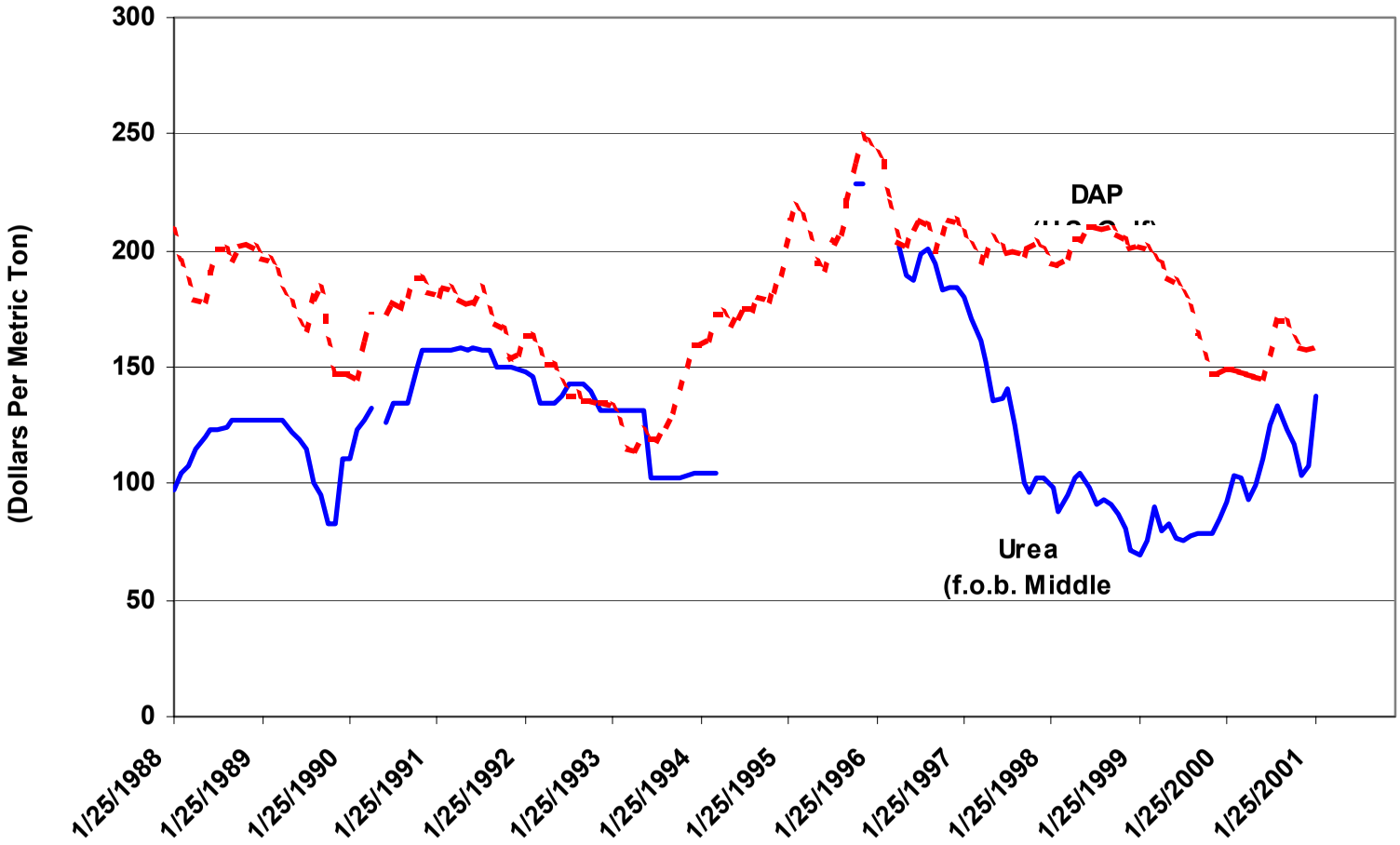
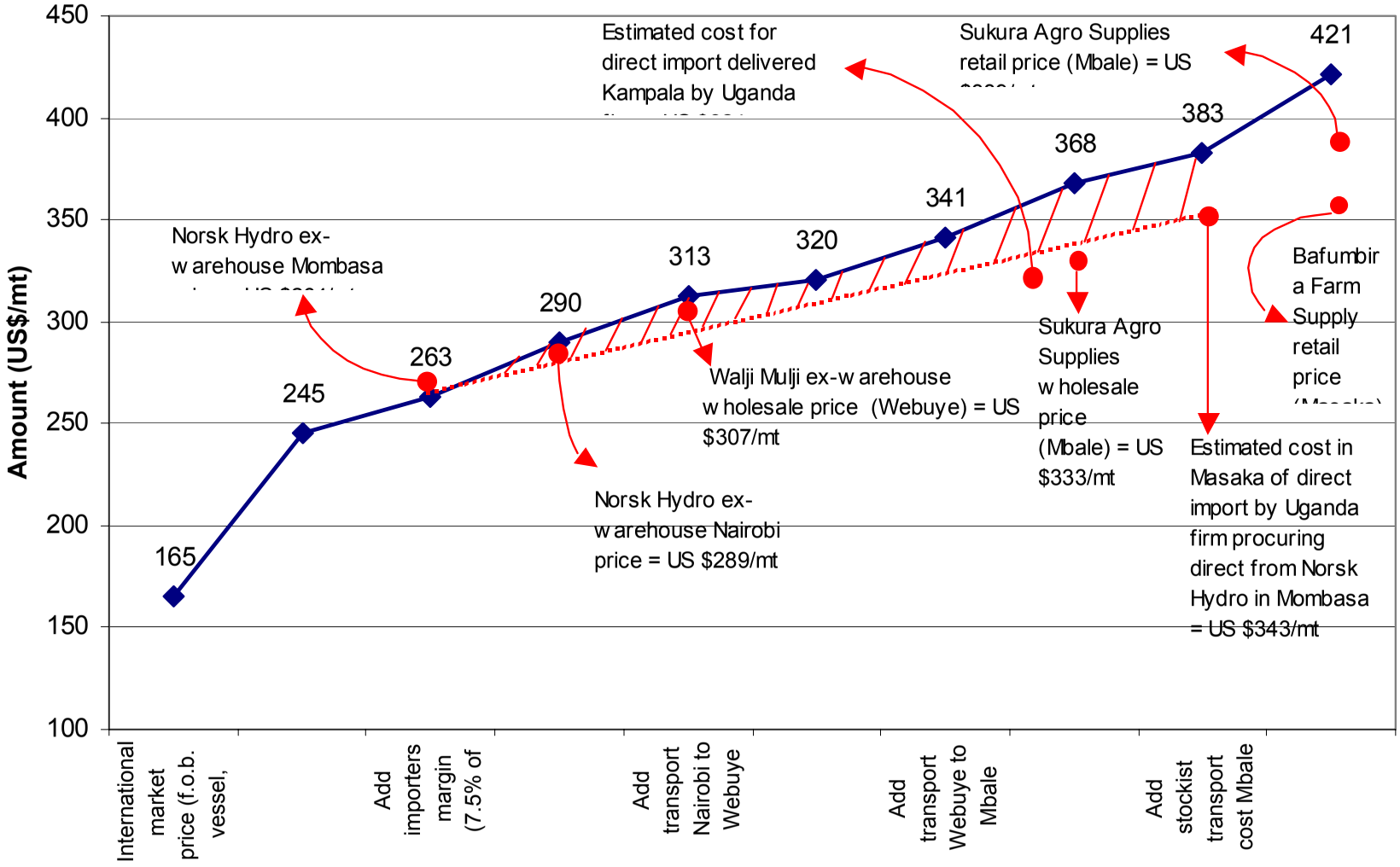


Figure 13. Estimated DAP Pricing and Cost Structure (December 2000)



8. Study of the Fertiliser Sector in Burundi

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Research on fertiliser use for cash crops in Burundi started well before 1960. For food crops, the earliest experiments with chemical fertilisers were carrried out in 1962 at ISABU (Burundi Agricultural Science Institute). But the use of fertilisers for food crops in rural areas was only really launched in 1972 under the FAO-supported Fertiliser Programme.

On the basis of ISABU research findings, the Fertiliser Programme carried out demonstrations of fertiliser use in rural areas with the following objectives :

- Carrying out simple experiments and demonstrations in farmers' fields in order to find out the degree of fertility and response of soils to fertilisers;
- Determining the economic impact of fertiliser use, with emphasis on the food-crop sub-sector, and dissemination of findings among farmers;
- Setting up, in areas where experiments and sensitisation have fostered demand for fertilisers, organisations for the distribution and marketing of fertilisers as well as the provision of loans to farmers and traders who require them;
- Training and helping agricultural agents/technicians and farmers in the techniques of utilising fertilisers and improved agricultural production, as well as in basic methods of fertiliser extension.

8.1. Evolution of Fertilizer Use in Burundi

The initial findings of the Fertiliser Programme in Burundi led to the launching in 1975 of a pilot project for fertiliser distribution, albeit on a small scale, in favour of food crops with a value cost ratio equal to or greater than two. The programme involved such crops as beans, peas, groundnuts, soya, maize, wheat, rice, sorghum, potatoes and cotton. It took into consideration the ecological conditions and agricultural calendar, while using improved production techniques (planting in rows, monocropping use of improved seeds, localised use of fertilisers, use of manure where possible on generally impoverished soils (pH $\geq$5.5)

The Government role was to facilitate the implementation of the Programme and to provide the required support (human and material resources, physical infrastructure etc.) for research, training and extension, distribution and marketing, until the opening of a revolving fund at the BNDE (Burundi Economic Development Bank).

The private business people were not interested yet in this programme the financial benefits of which were not immediately visible. It was agro-based entreprises (cash-crop and rural cooperatives) that came in to supplement Government efforts.

External assistance played a big role in setting up this Fertiliser Programme in Burundi, the areas of research at ISABU, training and providing initial human, material and financial resources. The main

aid donors involved were Belgium, Germany and the UNDP through FAO which was responsible for implementing the aid programme in this matter. Later on, Japan also made a very substantial contribution.

Table 1: Fertiliser Consumption (in tonnes) in Burundi from 1996 to 2000 by Crop and by Sector

Type of crop	Food crops (DPAES)			Cotton (COGERCO)		Coffee (OCIBU)	Palm Oil (OHP)	Sugar cane (SOSUMO)		
Year	DAP"18-46-0"	46% N Urea	KCl 60% K20	NPKSB "10-20-17-6-2"	46% N Urea	46% N Urea	KCl 60%K20	SPS 18% P2O5	46% N Urea	KCl 60% K20
1996	1,800	0	200	227	80	n.a	n.a.	n.a.	456	100
1997	2,200	50	100	305	99	n.a	n.a	333	254	127
1998	2,000	10	100	214	68	1,376	5	n.a.	131	200
1999	2,797	90.5	45.5	164	53	1,500	198	407	512	431
2000	3,041	8	0	88.5	29	2,000	153	668	383	389
Total	**11,838**	**158.5**	**445.5**	**998.5**	**329**	**4,876**	**356**	**1,408**	**1,736**	**1,247**

Type of crop	Rice (SRDI)		Tea (O.T.B.)	Tobacco (BTC)		Total
Year	NPK(10-20-20)	46% N Urea	NPK (20-10-10)	NPK (6-18-15)	46%N Urea	
1996	239	241	n.a	520	50	3,913
1997	280	311	n.a	520	50	4,629
1998	250	356	n.a	520	50	5,280
1999	400	511.5	2,800	520	50	10,479.5
2000	363	550	2,500	520	50	10,742.0
Total	**1,532**	**1,969.5**	**5,300**	**2,600**	**250**	**35,044**

N.B. Source : D.G.A. COGERCO, OCIBU, OHP, SOSUMO, SRDI, OTB, HPB
n.a.: not available; SB: boric sulfur

The above data do not reflect fertiliser needs during the period under consideration. What is reflected is simply the consumption of what was available. The needs are far greater, even though under current circumstances they are hard to assess.

Some crops with better economic return, as proved by studies or as generally assumed, are given top priority. Beans, Irish potatoes, wetland crops and cash crops get priority in fertiliser application because there is obviously a ready market for them.

8.2 Analysis of Fertiliser Utilisation in Burundi Over the Last 5 Years

Table 2: Crops and regions that received most fertilisers (in tonnes) over the last 5 years – in descending order.

Regions/crops	Central Plateau		High altitude	Low altitude				Eastern lowlands
Year	Food crops	Coffee trees	Tea plants	Rice	Tobacco	Cotton	Palm oil	Sugar cane
1996	2,000	n.a.	n.a	480	570	307	n.a	556
1997	2,350	n.a.	n.a.	591	570	407	n.a.	714
1998	2,110	1,376	n.d.	606	570	282	5	331
1999	2,933	1,500	2,800	911.5	570	217	198	1,350
2000	3,049	2,000	2,500	913	570	117.5	153	1,440
Total/crop	12,442 (35.5%)	4,876 (14%)	5,300 (15%)	3,501.5 (10%)	2,850 (8%)	1,327.5 (3.8%)	356 (1%)	4,391 (12.5 %)
Total/regions	**17,318 (49.5%)**		**5,300 (15 %)**	**8,035 (23 %)**				**4,391 (12,5%)**
Total/food crops/cash crops	**12,442 (35.5%)**	**22,602 (64,5%)**						
Grand total	**35,044**							

Source**:** Same as in Table 1.

Ecological Regions

- Low altitude: up to 1000m;
- Intermediate altitude: from 1000 to 1700m;
- Central Plateau: from 1700 to 2200 m;
- High altitude: 2200 m and above;
- Eastern (Moso) lowlands average altitude of 1300 m.

The central plateau region is the area with the highest fertiliser consumption. This is due to intensive agriculture and a higher population density than in other areas in the country.

The large share of cash crops in fertiliser consumption arises from the fact that they fetch high prices and from the availability of credit loans, even though these are rather limited.

Table 3: Classification of Total Fertiliser Use per Crop and per Region, following the importance of factors given below.

Factors	Crops	Regions
High response to fertilisers	Beans, groundnuts, soya, Irish potatoes, wheat, peas, rice (under irrigation)	Central plateau High altitude Low altitude
High prices for agricultural products	Beans, Irish potatoes, cash crops	Central plateau High altitude
Support activities For fertiliser promotion	Beans, peas, Irish potatoes, wheat	Central plateau High altitude
Fertiliser application rates	Beans, Irish potatoes	Central plateau High plateau
Low fertiliser price	Beans, Irish potatoes	Central plateau High plateau
Fertiliser accessibility	—	—
Availability of loans	—	—

Strictly speaking, there is no case where a single factor can determine fertiliser use on a given crop or region. It is rather the combination of those different factors that influences the decision in the matter.

8.3 Support activities to promote the use of fertilisers in Burundi

The FAO–run Fertiliser Programme in Burundi, which started in 1972, triggered fertiliser use for food crops and led to the setting up of the following :

- Revolving Fund for Fertilisers at the National Bank for Economic Development (BNDE);
- National Fertiliser Committee for the promotion of fertiliser use.

In 1993, the Programme became the Directorate of Soil Fertilisation and Protection, which was assigned to carry out the following:

- Developing the national fertiliser policy and supervising its implementation;
- Working out regulations to govern quality standards for fertilisers and other soil-enriching agents;
- Quality control for fertilisers and other soil-enriching agents.

Outside this programme, and often with FAO assistance, other promotional activities were carried out:

- Installation of a laboratory and a seed bank at ISABU and IRAZ;
- Establishing the Department for the Promotion of Seeds and Seedlings in 1992;

- Research on organic matter associated with fertilisers, such as azolla on irrigated rice, peat, etc;
- Intensification of research on soil liming using local lime;
- Setting up a rhizobium inoculum production unit for leguminous crops at ISABU;
- Construction of biogas units in rural areas for the production of high-quality manure;
- Research on local phosphatic rocks for fertiliser ;
- Launching of the Matongo Phosphate Project, and requesting external aid to carry out studies.

Table 4: Recommended Fertilizer Formulae and Application Rates by Crop and by Hectare

Crop group	Crops	Formula	Application rates
1. Leguminous crops	Beans, peas and groundnuts, soya	NPK 20-60-30 localised on seedbed	100 kg / ha of "18-46-0"
2. Cereals	Sorghum, maize	NPK 40-60-30 localised with 20N at earthing-up	100 kg of "18-46-0"plus 50 kg. of urea 46%N+50kg of KCl 60%
	Wheat	NPK 30-50-30 broadcast in the field before sowing	100 kg of "18-46-0" +25kg of urea +50kg of KCl
	Irrigated rice	NPK 40-45-45 broadcast before bedding out with 20N when crops are heading	100kg/ha of "10-20-20" plus 150kg of urea 46%N in 2 applications
3. Tubers	Irish potatoes	NPK 40-60-60 localised during planting	100kg of "18-46-0"+50kg of urea +100kg of KCl
4. Cotton	Cotton	NPK 50-50-30 localised with 20N at the flowering stage	Current application per ha : 200kg of NPKBS "10-20-17-6-2" and 50kg of urea 46 %N
5. Coffee	Coffee	NPK 100-20-40 for a density of 2,666 feet/ha, nitrogen being split into two applications.	Ingredients currently applied : 200kg / ha of urea 46% N in two applications
6. Tea	Tea	NPK 120-50-75 supplemented from time to time with Ca and Mg as per stage of growth : - young tea plants: NPK balance = 1-1-1-5 - Producing tea plants : NPK balance =5-1-1	- 400kg of "20-10-10"/ha in peasants' plantations - 600kg of "20-10-10"/ha in industrial estates
7. Tobacco	Tobacco	-	400 to 500 kg of "6-18-15"/ha according to the variety , plus 125kg of urea 46% N/ha.
8. Sugar cane	Sugar cane	-	- 300kg / ha of SPS 18% P205 over 3 years - 250 kg/ ha of urea 46%N and 250kg/ ha of KCl 60%K20 per year.
9. Oil Palm trees	Palm trees	-	1.5 kg of KCl 60% K 20 plus 0.25kg of Ca per plant, or 210kg of KCI plus 50kg of Ca per ha, before the start of the rains.

N.B. Anthropic soils (PH ≥ 5.5)

8.4 Analysis of Prices of Fertilisers and Agricultural Products 1998-2000

Table 5: Prices of Agricultural Commodities (in BF) per kilogram.

Crops / Year	Beans	Maize	Potatoes	Coffee		Tea	Paddy rice	Dry leaf tobacco	Cotton grain	Palm cluster	Sugar cane
				Berries	Beans	Green leaf					
1998	60	45	50	68	340	35	100 to 105	156	90	60	Industrial plantation
1999	150	50	100	90	420	45	130 to 135	210	10	60	
2000	200	50	100	100	450	60	200 to 205	224	120	60	

The food crops prices vary from one crop to another. From 1998 to 2000, Burundi's northern areas suffered severe drought, which led to production shortfalls with an impact on prices of agricultural products. With liberalisation, the real price offered to the producers, generally the lowest price, is observed during the harvest season and increases according to demand and supply. That is the price that normally serves as a basis for economic assessment.

Table 6: Fertiliser prices (in BF) per kg

Fertiliser / Year	For food crops (DPAEs)	Coffee (OCIBU)	Tea (OTB)	Rice (SRDI)		Tobacco (BTC)	Cotton (COGERCO)	Palm oil (OHP)	Sugar cane (SOSUMO)
1998	270	Subsidised 100%	240	380	Subsidised 100%	150	270	270	Industrial Plantation
1999	300		240	380		150	300	300	
2000	400		240	380		150	300	300	

The Government fixes the ceiling of prices for fertilisers sold to farmers.

8.5 Fertiliser Distribution and Marketing System

- Fertilisers are distributed and sold to farmers by private retail traders and cooperatives. These get their supplies from wholesalers, including government services, parastatals and projects or, rarely, from private importers.

- The government remains the major supplier of fertilisers to private retailers, given the volume of its imports which is facilitated by sure sources of import funds.

- The importance of cash sales in comparison to sales on credit:

- Private retail traders sell on cash terms to recover quickly their funds:
  - sales on credit are done through crop-specific production–and-marketing chains allowing repayment at harvest;
  - some industrial market chains completely subsidise the fertilisers they supply.

- The major constraints in the distribution and marketing of fertilisers in Burundi arise from the following:
  - The socio-political crisis, the consequences of which were aggravated by the economic embargo from 1996;
  - The foreign exchange shortage that resulted from the embargo, which was compounded by the instability of the rate of the Burundi Franc to the dollar;
  - Half–hearted fertiliser trade liberalisation, whereby private traders are faced with competition from the government which has greater access to credit.
  - Failure to quickly clear stocks, which makes traders afraid of committing a lot of money.

- The retailers complain often about their meagre profit margins (10BF/kg).

On the one hand, private dealers import very small quantities of fertilisers on their own initiative. They mostly do it following the needs expressed by the government department concerned (DPAE) and through calls for bids announced by agro-industrial companies.

On the other hand, the Government hesitates to withdraw completely from the sector, for fear of being faced with fertiliser scarcity in case the dealers were to engage in more lucrative speculation.

8.6 Fertiliser Imports Over the Last Five Years (1996-2000)

Table 7: Fertiliser imports over the last 5 years, from 1996 to 2000 (quantities in tonnes and value (CIF Bujumbura) in million BF).

Year	1996		1997		1998		1999		2000	
	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
Fertiliser Qty/ value	4,444	448.5	5,638	803.1	6,797	1,250.2	9,968	2,241	4,402	1,162.7
Official Exchange rate BF/US$	302.75		352.35		447.77		563.56		735.465	
Parallel Market rate BF/US$	410		530		800		1000		950	

Source: BRB annual reports

- Source of fertilisers: European Union and Mauritius

- Potential importers:
  - Chimusa Emmanual Nyankiye
  - APPRO – SERVICES
  - TEMBO

- Import funds :
  - Submission of bids ;
  - Own funds (where possible)

- Constraints
- The liberalisation policy supported by the World Bank is not fully implemented;
- The profit margin for importers is considered low; it should be around 15% after deducting bank charges;
- There are tough conditions for bank guarantees which restrict access to import credit;
- The country is in a hard predicament because of the socio-political crisis.

- Fertiliser importation system:

Importation is done through bid submissions, the successful bids being funded by government facilities and / or external aid mostly; in a few cases, some private enterprises (e.g. BTC) import on their own.

- Participants:

  Government (public services, parastatals and projects) through the Tender Board Directorate;
  Private traders;
  Bilateral and multilateral aid sources,
  NGOs.

- Importers: private dealers awarded tenders after calls for bids.

- FOB prices:

  Indicative prices FOB Dar-es-Salaam are as follows (for 2000):
  Urea: 240 BF per kg
  NPK: 280 BF per kg
  DAP: 300 BF per kg
  KC1: 280 BF per kg

8.7 Government Policy on Fertiliser Use

The importance attached to chemical fertiliser use in agriculture

This importance arises from the government objective of promoting a sustainable, durable system for the supply, production and distribution of agricultural inputs as well as a system for marketing of agricultural products and management of agriculture, through the development of a national policy on agricultural inputs that will give incentives to the private sector, cooperatives and agricultural associations. This comes out clearly in the Structural Adjustment Policy adopted in 1986. The Government is therefore committed to boosting production through the increase of agricultural productivity per acre, by providing support to producers based on research and dissemination of innovations and information.

Measures taken to promote fertiliser use with special emphasis on price factors *(e.g. higher prices* ***for agricultural products, subsidies for fertilisers.).***

Apart from strategic cash and food crops for which minimum prices are fixed for the producer , the prices of other agricultural food products have been liberalised and depend, therefore, on the law of demand and supply.

As for fertiliser subsidies, government policy was for a long time to supply the fertilisers free of charge or at subsidised prices to the producers. The Ministerial Order No. 540/029 of 1st March 1994 specifies the local tax and customs advantages given exclusively in favour of agricultural and

livestock inputs and equipment. The subsidy for fertilisers is limited to their tax exoneration. But certain projects and enterprises subsidise the distribution of fertilisers.

Selected seed varieties and related credit are included in the category of agricultural inputs, while agricultural extension campaigns are entirely the responsibility of the government.

Fertiliser Distribution and Marketing System

According to the Structural Adjustment Policy in the agricultural sector, the government has to pull out of production, manufacturing and marketing activities and to concentrate on the role of regulating and promoting the sector, thereby enhancing the development of the private sector, including producers' groups and associations.

Following the setting up of the Revolving Fund at the BNDE, the government created the National Fertiliser Committee. At present, only funding, physical infrastructure and extension are still under government responsibility. Otherwise, the handling of fertilisers is left to private dealers and cooperatives who sell the products under the indirect monitoring of the local administration and the technical monitoring on the ground by agricultural officials. The ceiling price of fertilisers sold to farmers is fixed on the basis of the cost price, including transport costs, to which is added a reasonable profit margin. The sale of fertilisers is, therefore, in private hands.

Imports of fertilisers

Generally, fertilisers are imported by private importers following international calls for bids made by the National Tender Directorate. The importations are funded by the government (Revolving Fund and budget appropriations) and / or external aid. The physical infrastructure (depots, etc.) remain the business of the government.

The policies are inadequate for proper development of the fertiliser distribution and importation system, especially:

- in taxation matters, as mentioned above, (Ministerial Order No. 540 / 029 of 1st March 1994), fertilisers are exonerated ;
- with regard to importation and distribution, even though these are in private hands, the availability of funds leaves a lot to be desired:
- private dealers rarely use their own money in this trade;
- government funding and external aid are limited.

8.8 The Role of External Aid in the Development of Fertiliser Sector Activities

External aid has played a big role in the development of the fertiliser sector activities in Burundi. At the request of the Burundi Government and with the assistance of Belgium and UNDP, the FAO launched the Fertiliser Programme for food crops in 1972.

At the time of launching the distribution of fertilisers in 1975, Germany offered large quantities of fertilisers to Burundi. This gift helped set up the Revolving Fund at the BNDE for the importation and sale of fertilisers at subsidised prices (after removal of taxes). This was conditional on initial matching funds from the government budget that is repeated every year. Taking into account the extremely encouraging results obtained, Burundi requested aid in form of fertilisers from donors and received a lot of fertiliser donations from Japan and other aid donors, both bilateral and multilateral, as a contribution to its food security.

8.9 Important Observations and Conclusion

Despite importations made on orders based on estimates of real needs, stocks often remain unsold. This is what explains the data on table 1 compared to the data on table 7, where one would tend to think that fertiliser use in 2000 was higher than fertiliser imports.

In reality, there is not yet any serious speculation in the fertiliser sector, due to the following : its marketing promotion is still in its early stages, local consumption is still low, cost price is high and there is little money in circulation in the rural areas.

The government is concerned about providing agricultural inputs through private importers at affordable prices and promoting the privatisation of agricultural enterprises (coffee, rice, tea, etc.) in a bid to maximise productivity.

Despite that liberalisation, fertiliser trade in Burundi does not, in the opinion of private enterprises, offer enough volume for the latter to commit their capital without risk, because of uncertain markets for immediate sale or for sales overtime in comparison with other commodities (cement, salt, etc.) That is why there is no private fertiliser store. We may note, however, that some importers (CHIMUSA and TEMBO) are currently trying to make available some tons for direct sales, but it is on tentative basis.

The fixing of the price ceiling for offers to farmers is part of the general internal trade control, which takes into account transport costs and the profit margin, in order to protect the consumer.

Fertiliser outflows are for the time being impossible, given that private importers make their deliveries at the recipients' depots. The recipients choose dealers for sales in communes, where supplies are made according to the needs indicated by farmers' associations, with the assistance of extension workers who monitor the storage conditions and effective use of these fertilisers in the fields. All this is done under the watchful eye of local administration officials.

Private enterprises dominate 100% the importation of fertilisers for third parties that provide financing and physical facilities for the sector. Wholesale trade is 100% in the hands of those enterprises financing the imports.

The internal retail market is 60% controlled by private enterprises and cooperatives that sell and distribute these fertilisers for cash. Companies like BTC (tobacco), COGERCO (Cotton), OHP (palm oil) and OTB (tea) market fertilisers through their extension workers in the field, offering them on

credit and waiting to be repaid at harvest. Sometimes a subsidy is granted, but the loss entailed may be recovered in the pricing of the produce or finished product.

Current plans for the privatisation of the sector involve efforts to steadily interest private enterprises in investing more in fertilisers and improving their financing and accessibility. The Government continues to implement divestiture policy to pull out of production and marketing sectors by selling its public enterprises or offering shares in such enterprises to private business people.

Research on extension based on fertiliser use in Burundi has shown good results for better crop productivity. There is still need to enhance fertiliser availability and to boost agricultural production.

9. Sustainable Rapid Growth of Fertiliser Use in Rwanda: a Strategy and an Action Plan

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This document presents a strategy and an action plan for sustainable rapid growth of fertilizer use in Rwanda. It is based on:

1. The author's October 1997 paper (Growth of Food Production in Rwanda: Critical Importance of Chemical Fertilizers).
2. Papers and proceedings of a policy workshop on Fertilizer Use and Marketing organized by Abt Associates Inc., in Kigali on February 22 and 23, 2001
3. Discussion with policy makers, representatives of donor agencies, ISAR scientists and other researchers, agricultural officers, private-sector importers and dealers, and farmers in Kigali, Butare, and Gikongoro in October 1998, and in Kigali and Ruhengeri between February 10 and 28, 2001.

9.1 Context of the Workshop

The workshop was organized in the context of growing population pressure on land, and the agricultural strategy of intensification and commercialization adopted by the Government of Rwanda. The success of the strategy is crucial in tackling the problems of widespread poverty, unemployment and food insecurity. The most formidable constraints to continuous growth in per hectare yields are depleted soil fertility, declining organic manure use and persistent low use of chemical fertilizers. Hence, removing the soil-fertility constraint is the single most important task in the intensification of Rwanda's agriculture.

The experience world over has established that overcoming soil-fertility constraints is not possible without the use of chemical fertilizers – not even in countries like China and Japan with most meticulous record in mobilizing organic sources of plant nutrients. Surely, improvements in the traditional fertility management practices, and environmentally benign technology (e.g., biological nitrogen fixation) have a definite *complementary* role. But considering them as substitutes for fertilizers in meeting increasing requirements of plant nutrients is naive.

Therefore, the pertinent question before the workshop was not *whether* to increase fertilizer use but *how* to generate rapid and sustainable growth of fertilizer use with an ultimate objective to make prudent policy recommendations.

The papers discussed in the workshop assessed the scope of growth of fertilizer use, identified difficulties in raising the present level of use, examined alternative ways to overcome critical bottlenecks, and reviewed experiences of other developing countries to draw policy lessons useful to Rwanda.

9.2 Papers and Proceedings

The paper by Kelly, Mpyisi, Murekezi and Neven reviewed the past trends in fertilizer consumption, drew attention to present pattern of fertilizer use and farmers' difficulties in using this input, and presented estimates of the agro-economic potential of fertilizer use. Murekezi presented an overview of the place of fertilizer in agricultural and extension systems of Rwanda. The two papers by Cook reviewed fertilizer marketing and imports, and also drew attention to notable recent developments. Nyirimana highlighted the potential and constraints of the Agricultural and Rural Market Development Project. Finally, the papers by Allgood & Bumb and by Niyungeko covered the evolution and characteristics of fertilizer-sector development in four East African countries – Kenya, Uganda, Tanzania and Burundi.

There was a clear consensus on the need to step up fertilizer use in Rwanda, but without downplaying the importance of organic manure and soil conservation. A variety of difficulties in rapid growth of fertilizer consumption were also pointed out. These pertained to farmers' low effective demand due to lack of experience and knowledge in fertilizer use, cash constraints, non-availability of fertilizers at convenient locations, and high prices of fertilizers. On the supply side, the principal obstacles were the rudimentary state of fertilizer distribution, as well as unsteady growth in, and high cost of, fertilizer imports to land-locked Rwanda.

At the same time, the papers and workshop discussion also revealed some positive signs about the prospects of growth in fertilizer use. There was a substantial scope for profitable use of fertilizers under the prevailing environment of responses of crops to fertilizer application and prices of crops and fertilizers. Fertilizer was given a prime place in the strategy of intensification and commercialization. This was in sharp contrast to the policy to discourage fertilizer use for many years. More importantly still, the government had begun the process of creating an enabling policy environment for growth in fertilizer use. Subsidized distribution of fertilizers received under foreign aid was discontinued, and this input was exempted from 15% value-added tax (VAT) and 5% import tax. Also, the Agricultural and Rural Market Development Project (ARMDP), supported by the World Bank, was launched in 2000. It is:

1. Providing a Line of Credit at subsidized interest rates (9% rather than the market rate of 16%) to fertilizer importers, and distribution system.
2. Creating fertilizer awareness among farmers and training them in fertilizer practices.
3. Improving output marketing facilities.

To further expand the geographical base of growth in fertilizer use, the Ministry of Agriculture has launched a program of fertilizer demonstrations.

All these developments have had a clear positive impact on the fertilizer scene. Total fertilizer imports in 2000 were in excess of 8,500 tons (materials). Nearly a quarter of this was due to the private-sector system that had come into existence in response to the exemption of fertilizers from VAT and import taxes, and to increasing fertilizer demand of Irish-potato growers.

9.3 A Caveat – A Low-Level Equilibrium

The above developments of 2000, however, may not suffice to initiate *sustained* rapid growth of fertilizer consumption because of three interrelated reasons.

First, the base generating growth in farmers' demand for fertilizers is too small. Only about 5 percent of farmers are using fertilizers on tiny proportions of their cultivated land, and that too mainly on a couple of crops (e.g., Irish potatoes, coffee and tea) at a few locations in some prefectures.

Second, there is widespread skepticism about the potential size of fertilizer market, especially among importers in the formal system. This is based not only on the present ground-level realities of very sparse fertilizer use but also persistent low levels of total fertilizer consumption for the past three decades. Consequently, the importers in the formal system are hesitant to rapidly enlarge fertilizer imports. More so because of their difficulties of operating in the world fertilizer market for meager quantities, a long lead-time, and competition from the small importers in the informal system. The latter do not appear as conservative as those in the formal system in assessing the potential size of fertilizer market. But they have their own constraints in rapidly enlarging total fertilizer imports (e.g., only a few operators, small size of consignments, limited geographical coverage of the market they serve).

Third, the fertilizer distribution system is severely underdeveloped. This is not only because of geographically-dispersed low volume of farmers' fertilizer demand but also because there is no pressure from the supply side due to slow and uncertain growth of fertilizer imports. Consequently, farmers experience difficulties in readily obtaining fertilizers, even at locations where fertilizer demonstrations are currently underway.

Under the mutually-reinforcing effects of these circumstances, Rwanda's fertilizer sector is in a state of a low-level equilibrium – in a vicious cycle of small aggregates. Despite profitable opportunities for fertilizer use, the base generating farmers' effective demand for this input does not expand rapidly. This is because of non-availability of fertilizers at geographically dispersed locations. The resulting small volume of fertilizer business does not induce geographical expansion of the fertilizer marketing system. And this, in turn, leads to slow and unsteady growth in total fertilizer imports.

9.4 Way Out -- A Big Push

One way to break this vicious cycle is to give a relatively big push to growth in fertilizer use for a few consecutive years – annually by no less than 5,000 tons (material) for three consecutive years. This would raise the total annual fertilizer consumption from about 8,000 tons (materials) in 2000 to about 25,000 tons in 2003. In fact, total consumption in 2003 could be much higher than 25,000 tons if appropriate policies were adopted to facilitate growth of fertilizer use on tea and coffee.

The experience of an annual increment of at least 5,000 tons in fertilizer use for three successive years could be expected to break the vicious cycle. First, it will replace the diffident attitudes of many farmers' associations, NGOs, traders, importers and even policymakers with an optimistic and forward-looking mindset. Second, by raising the volume of fertilizer business, it will encourage the participation of those dealers and importers for whom economies of scale are important for high returns to their investment and efforts in the fertilizer-sector activities. Finally, it will rapidly increase the number of farmers using fertilizers from just 5 percent to more than 15 percent. This will have a substantial and visible impact on the trends in crop yields and farmers' income.

The Big Push will also put *all* fertilizer-sector activities – from imports to ultimate use by farmers – on a sound footing. This is necessary to raise total annual consumption to more than 60,000 tons (material) over a 10-year period. Against the backdrop of the present level and three decades of virtual stagnation, such growth in fertilizer consumption may seem incredible. But the experiences of many developing countries suggest that it is a perfectly feasible goal. What makes it worth striving for is that it will have a decisive impact in overcoming widespread soil-fertility constraints, and thus generating poverty-mitigating broad-based agricultural growth. This is the perspective from which merits of the Big Push should be judged.

9.5 Scope for the Big Push

The scope of the Big Push is clearly indicated by the estimate of agro-economic potential of fertilizer use made by Kelly, Mpyisi, Murekezi and Neven in their workshop paper. Even with the conservative assumptions (e.g., value-cost ratio (VCR) of 3 or more), they estimate this potential at about 23,000 tons (materials).

This estimate relates to only 16 percent of the area under seven crops for which the authors had the data to study fertilizer responses and calculate VCRs. The seven crops are sorghum, maize, beans, soybeans, Irish potatoes, sweet potatoes, and vegetables. On the remaining 84 percent of the area under these seven crops, there could be some area with VCR of 3 or more. This possibility is very real because the estimate of 23,000 tons covers only 61 percent of the area under Irish potato, and just 3 to 4 percent of the area under maize and vegetables. But this is not all. Crops not covered in the estimate of 23,000 tons include rice, wheat, peas, groundnut, bananas, taro, cassava, fruits, tea and coffee. There must be substantial potential on area under crops like rice, bananas, tea and coffee. Tea and coffee occupied 36,000 hectare (10,000 tea + 26,000 coffee). In 2000, 5,400 tons of fertilizer was imported for OCIR-Thé and OCIR-Café. According to the technical services of these organizations, fertilizer requirements of tea are about 15,000 to 20,000 tons and that of coffee another 26,000 tons. All this suggests that the present size of the agro-economic potential -- at VCR of 3 or more -- must be much larger than 23,000 tons.

Furthermore, the potential is bound to go up over time for three main reasons. First, with commercialization, cropping patterns will change towards greater areas under climbing beans, Irish potatoes, vegetables etc. Second, improved fertilizer-responsive varieties will replace traditional varieties. Third, the rice area will expand due to swampland development under the new World Bank project (the Rural Sector Support Project).

It is thus clear that the total fertilizer consumption of only about 8,000 tons in 2000 was only a small fraction of the profitable potential of fertilizer use. Once consumption on tea and coffee is excluded, total consumption on the non-beverage crops in 2000 was much less than even one-third of the partial and conservative estimate of about 23,000 tons made by Kelly, Mpyisi, Murekezi and Neven. This should leave no doubt that there is a vast scope for the Big Push to break the vicious cycle of small aggregates. It also follows that this can be done without fertilizer subsidies since VCR of 3 or more implies high profitability of fertilizer use. What is needed is the right strategy and its decisive implementation.

9.6 Strategy for the Big Push

In developing the strategy for the Big Push, it is important keep in mind three things. First, sustained growth in total fertilizer use requires increasing number of farmers adopting fertilizer on all crops that are potentially profitable to fertilize at growing number of locations. Second, this depends on the conversion of the fertilizer potential into farmers' demand for this input, *and* this demand being met by fertilizer distribution and supply systems. Third, this depends on well-coordinated thrusts on both fertilizer demand and supply sides at all levels from micro-locations to the national level.

These considerations, though obvious, must guide the design of the strategy, and also the efforts to implement it. Even after about 30 years since it was introduced in Rwanda, fertilizer was being used in 2000 by only about 5 percent of farmers, and that too mainly on a couple of crops at a few locations. This was so not because profitable opportunities of fertilizer use on many more crops at numerous locations were lacking. It was an outcome of historical developments that bypassed these opportunities.

Therefore, the strategy for the Big Push must *simultaneously* address three problem areas in *a well-coordinated manner*:

- absence of vigorous growth in farmers' effective demand for fertilizers
- non-availability of this input at convenient locations
- slow and uncertain growth of total fertilizer imports.

9.7 An Action Plan to Implement the Strategy

The prime instrument of the Action Plan should be a program of fertilizer demonstrations. It should be complemented by an enabling policy environment that expands the distribution networks and facilitates the required growth in total fertilizer imports. Although the private sector dominates these two supply side activities, the Action Plan is based on the government providing leadership in taking initiatives, and facilitating sound development of the distribution and import systems.

Fertilizer Demonstrations

A well-thought out and effectively implemented program of fertilizer demonstrations is recommended to accomplish two objectives:

1. To rapidly covert the agro-economic potential into farmers' effective demand for fertilizers by convincing farmers about the profitability of fertilizer use and providing them the knowledge of technically sound fertilizer practices.

2. To convince local shopkeepers, input dealers, cooperatives and regional wholesalers about the potential size of the fertilizer markets, and thus improve availability of fertilizers at convenient locations.

Conventionally, fertilizer demonstrations aim only at the first goal. This is not sufficient to convert the agro-economic potential into actual fertilizer use since fertilizers are not readily available to farmers, as is the case in many parts of Rwanda. The resulting chronic low fertilizer use constrains geographical expansion of the fertilizer distribution system. This, in turn, reinforces perceptions on the part of wholesalers and importers of the small size of fertilizer market. This trap could be avoided through exposing potential local participants in the fertilizer distribution system to fertilizer demonstrations, and facilitating their participation in fertilizer distribution through simple training programs and credit policy. This would result in easy availability of fertilizers to farmers from local shopkeepers, weekly markets, and mobile vans of regional dealers. This, in turn, would not only initiate geographical expansion of the distribution system but also change the perception of the size of fertilizer market of wholesalers and importers.

To begin with, the demonstration program should focus on selected crops in agro-climatic regions where farmers' returns on fertilizer use are high. These regions are already identified for seven crops in the research carried out by Kelly, Mpyisi, Merekezi and Neven. To these seven crops, selected areas under rice and a few other crops may be added where *a priori* reasoning suggests high profitability of fertilizer use. The demonstration program should also cover locations selected for the Agricultural and Rural Market Development Project since this project also aims at promoting the use of modern inputs.

Steady Growth in Total Fertilizer Imports

This is just as important as fertilizer demonstrations. Without *simultaneous* growth in total fertilizer imports, neither can actual fertilizer use go up nor can there be much expansion in the fertilizer distribution networks. Thus, the demonstration program, by itself, is not enough to get out of the low-level equilibrium.

Total imports in 2000 were considerably larger than in any year of the post-genocide period. This could be attributed to the policy of liberalization and the exemption of fertilizers from VAT (15%) and customs duty (5%). However, it would be a mistake to assume that the current fertilizer-import system is sufficient to raise the volume of imports from about 8,500 tons in 2000 to over 25,000 tons by 2003.

As the information provided by Cook in his workshop paper shows, out of the total imports in 2000 of 8,537 tons, the formal system imported 6,537 tons. But 5,400 tons (83 percent) was for OCIR-Thé and OCIR-Café. On its own account, the formal system imported only 1,137 tons for the non-beverage crops. Against this, the informal system in the private sector imported approximately 2,000 tons – nearly twice as much as the formal system – for non-beverage crops. These facts plus the lukewarm response of the formal system to avail of the Line of Credit facility provided under the Agriculture and Rural Market Project (ARMDP) suggest that the formal system alone cannot be relied upon for the required growth in total fertilizer imports for crops other than tea and coffee to implement the strategy of the Big Push. Its principal difficulty at present is skepticism about the potential size of the fertilizer market, and not working capital constraints.

Therefore, in implementing the strategy of the Big Push, the formal and the informal import systems should be viewed not as alternatives. The small-scale informal system has come into existence in response to changes in the policy environment, the formal system's hesitation to respond to these

changes, growing fertilizer demand of Irish potato growers, and opportunities to meet this demand through legitimate imports from neighboring countries. All this is quite consistent in the evolution of a market-oriented competitive import system run by the private sector.

Clearly, the formal system that imports fertilizers from the world market (rather than from big importers in neighboring countries) has its own advantages. But the profitability of this system depends, to a large extent, on economies of scale which cannot be reaped until the present low level of total fertilizer use reaches a much higher level. The informal system has come into existence through initiative and enterprise of small entrepreneurs. It appears to be the best modality for growth in total imports needed to raise consumption up to the level where economies of scale in imports from the world market become possible. One could further argue that a vigorous growth of the informal system under the present circumstances would be advantageous to the formal system in the long run. It could then act as a network of wholesalers for the fertilizers imported from the world market.

The present informal system, however, is too small to generate the growth in total fertilizer imports required for the Big Push. It needs to be substantially expanded by encouraging the entry of more private-sector entrepreneurs in fertilizer imports. In addition to training programs (discussed later), two things are needed for this purpose:

- to avoid excessive regulation of the legitimate operations of the informal system
- to extend the credit-guarantee facility to importers in the informal system.

The possibility of regulations is indicated by the concern for quality of fertilizers imported by the informal system from neighboring countries. It is difficult to judge how far this concern is valid because of the widespread ignorance about the technical aspects of chemical fertilizers. It is also unclear if the quality-related complaints are due to the stiff competition offered by the informal system to the formal system in fertilizer business.

Furthermore, when substantial proportion of sales at the retail level are from open bags in small quantities (from a few kilograms to 25 kilograms), rigorous quality control through prosecutable violation of law will be extremely difficult. Because of all these reasons, it appears premature to enact a legislation to control quality of fertilizers at this stage. This could easily discourage the nascent private sector from participation in fertilizer distribution and imports. Clearly, this will have negative impact on growth of fertilizer imports and its flows in the distribution networks.

Many developing countries have found that quality-related complaints are far more common in times of fertilizer scarcity. All these reasons suggest that a prudent strategy to control quality of fertilizers, at this stage, is farmers' and dealers' education in technical aspects of fertilizers, competition at all levels in the marketing channels, and steady growth in total fertilizer imports.

It is also recommended that the exemption of fertilizers from VAT and customs duty for three years should be extended by two more years by a presidential decree. This will remove uncertainty from the minds of importers in both the formal and informal systems, and encourage them to enlarge imports in response to the impact of fertilize demonstrations on farmers' demand and the fertilizer distribution system. Furthermore, it will keep fertilizer prices that much lower for farmers. Actually, given the need for sustained growth in fertilizer use for intensification for many years, and the fact that CIF fertilizer price in Kigali is more than 50 percent higher than in Mombasa or Dar-es-Salaam, there is a strong case for "permanent" exemption of fertilizers from taxation.

Training Programs

To facilitate sound development of the fertilizer distribution and import systems, two types of training programs are needed:

- one for the ground-level functionaries (e.g., retailers, regional dealers, cooperatives)
- another for wholesalers and importers at the national level.

The training program for ground-level functionaries should be coordinated with the program of fertilizer demonstrations. It should be designed to train retailers and regional dealers in the basics of chemical fertilizers, the essential nature of the fertilizer business (including the importance of inventory management), and the use of credit facilities to enlarge the volume of business.

The program at the national level should pay particular attention to the role importers and wholesalers could play in geographical expansion of the distribution network. Additionally, it should cover working-capital management (including the use of the credit-guarantee facility) and scanning the opportunities for regional collaboration in fertilizer imports to maximize economies of scale.

In both training programs, particular attention should be paid to effective use of credit facilities. As fertilizer use spreads among farmers and from cash to non-cash crops, availability of credit will become increasingly important in sustaining rapid growth in farmers' effective demand for this input. Similarly, working capital requirements in the fertilizer-distribution and import systems will also increase with a growing volume of fertilizer business. All these considerations suggest the merits of involving commercial banks in these training programs. That will facilitate meaningful interactions between fertilizer-distribution and import systems, on the one hand, and credit institutions, on the other.

Both training programs should use case studies based on experiences in Rwanda. The International Fertilizer Development Center (IFDC) has considerable experience in providing training to fertilizer-sector functionaries in developing countries. It may be contacted to develop the above training programs.

Department of Marketing Services

Given the widespread soil-fertility constraints, expeditious implementation of the Action Plan is crucial for intensification and commercialization of Rwanda's agriculture. This requires simultaneous and well-coordinated progress in overcoming all major obstacles to sustainable rapid growth in fertilizer use. Although the private sector dominates activities on the supply side, the Action Plan requires the government to play key leadership and facilitating roles at both ground and national levels.

This is not a one-shot task. Once rapid growth in fertilizer use is underway, new problems are bound to emerge because the situation will not be in a state of low-level equilibrium. The new problems could be in the activities of the fertilizer sector (e.g., inadequate growth in total imports, regional imbalances in demand for and supply of fertilizers, infrastructure constraints in smooth flows of fertilizers in the distribution networks). Nor need the problems be confined only to the fertilizer

sector activities. To illustrate, improved seeds – on which profitability of fertilizer use depends – may be in short supply. Similarly, rapid growth in fertilizer use may depress crop prices by enlarging the marketed surplus. The government has a crucial role to play in resolving such problems until markets for inputs and crops are very well developed. This is even more so in the case of rapid growth in fertilizer use since it sets in motion many processes behind technological transformation and commercialization of traditional agriculture.

A Department of Marketing Services (DMS) should be set up in the Ministry of Agriculture to facilitate the overall process of intensification and commercialization of Rwanda's agriculture. Given fertilizer's critical importance for intensification, the DMS should give a very high priority to providing leadership in *sustainable* rapid growth in fertilizer use. To assist the Director of the DMS in discharging this responsibility, a Fertilizer Division should be set up in the DMS.

The DMS should play a key role in implementing the Action Plan. Its overall task should be to facilitate simultaneous and well-coordinate progress in the three thrusts of the strategy behind the Big Push:

1. Sustained growth in demand for fertilizers.
2. Geographical expansion of the fertilizer distribution system.
3. Steady growth in total fertilizer imports.

This implies an active role by DMS in monitoring the progress of the Action Plan with respect to:

- fertilizer demonstrations, and their impact on:
    1. generating sustainable growth in farmers' effective demand for fertilizers
    2. improving availability of fertilizers to farmers at convenient locations
- growth in total fertilizer imports by the private sector in formal and informal systems
- expansion of the informal fertilizer-import system through entry of more private-sector entrepreneurs in fertilizer imports
- training programs at the two levels to enhance the capabilities of the private sector in fertilizer distribution and imports
- improvements in the availability of credit to farmers as well as fertilizer distributors and importers
- prices of crops and fertilizers, especially at locations where fertilizer use is rising rapidly.

The DMS should also analyze the above monitoring information to identify emerging problem areas for timely actions by both other Departments and Ministries of the Government as well as by the private sector. For this purpose, it should develop appropriate mechanisms (e.g., coordination committees, liaison with the private sector).

Workshop Programme

MINAGRI
Policy Workshop: Fertiliser Use and Marketing
MINAGRI meeting room (Department of Agriculture)

Day 1: *Thursday, 22nd February 2001*

09:00 **Opening**
Chair: Dr Andy Cook, Abt Associates Inc.

Hon. Aaron Makuba, Secretary of State for Agriculture, MINAGRI: *Opening address*
Dr Menweyellet Moussie, USAID: *Opening remarks*
Dr John Mellor, Abt Associates Inc.: *Summary of approach*
Dr Gunvant Desai, consultant: *Orientation*

10:00 *Coffee and tea*

SESSION 1
Chair: Mugunga Rémy, Director of Poverty Reduction, President's Office

10:30 **Paper 1**
Dr Valerie Kelly & Edson Mpyisi (Michigan State University):
Consumption, demand and potential for chemical fertiliser use
Discussants:
Laurent Gashugi, National Programme Officer, FAO
Anastase Murekezi, consultant

12:30 *Lunch*

SESSION 2
Chair: Vincent Ngarambe, Director of Rural Engineering and Soil Conservation, MINAGRI

14:00 **Paper 2**
Anastase Murekezi (consultant): *Agricultural research and extension*
Discussants:
Venuste Ruhigana, MINAGRI chair of the FAO/MINAGRI *Soil fertility initiative*
James Nsengiyunva, Association IMBARAGA

15:30 *Tea and coffee*

16:00 **Paper 3**
Dr Andy Cook (Abt Associates Inc.): *Distribution/marketing of chemical fertiliser*
Discussants:
Innocent Simpunga, Chercheur-Formateur-Agronome, CSC Gitarama
François Musegayezu, Murenzi Supply Company

17:30 *End of Day 1*
Day 2 *Friday, 23rd February 2001*

SESSION 3
Chair: Eugène Rurangwa, Directeur of Lands, MINITERRE

08:30 **Paper 4**
Dr Andy Cook (Abt Associates Inc.) : *Imports and the import system*
Discussants:
Donatien Murenzi, importer, Kigali
Eyadéma Jean-Bosco, Director of Trade, MINICOM

10:00 *Tea and coffee*

10:30 **Paper 5**
Joseph Nyirimana (World Bank, ARMDP):
The Agricultural and Rural Market Development Project: potential and constraints
Discussants:
Pierre Claver Gatwaza, Head, Agricultural Planning, MINAGRI
Rutagarama Saleh, importer, Ruhengeri

12:00 *Lunch*

SESSION 4
Chair: Mme Mukarusagara Tassiana, Secretary General, MINAGRI

13:30 **Papers 6**
Dr Balu Bumb (consultant): *Fertiliser sector in other East African countries*
Dr John Mellor (Abt Associates Inc.): *Fertiliser sector in Burundi* (Novat Niyungeko)
Discussants:
Vincent Ngarambe, Director of Rural Engineering & Soil Management, MINAGRI
Dr Venuste Murinda, Director of Extension and Marketing, MINAGRI

15:00 *Tea and coffee*

15:30 **Summing up**
Dr Gunvant Desai (consultant): *Implications for policy in Rwanda*
Discussants:
Kalisa Mbanda, Head of Strategic Planning/Agriculture, MINECOFIN
Mugunga Rémy, Director of Poverty Reduction, President's Office

17:30 **Closing**
Dr John Mellor, Abt Associates Inc.: *Conclusions*
Dr Ephraim Kabaija, MINAGRI Minister: *Closing address*

18:30 *Reception*